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VOL. XXIX MAY, 1931 No. 5

The Society is not responsible, as a body, for the facts and opinions advanced in the papers published by it.

EDITORIAL

THE PUBLIC LAND REPORT A THREAT TO CONSERVATION

THE RECENTLY released report of the Committee on the Conservation and Administration of the Public Domain is received by some as being statesmanlike and by others as inimical to genuine conservation. A perusal is convincing that it is a clever compromise between the views of those who adhere to states rights and those who believe that true conservation of the resources concerned can be attained only through federal control. In an effort to appease all, it satisfies none. The report is of vital concern to foresters whose interest lies beyond the mere raising of trees. It deals with a great land economic problem. The area involved approaches very close to 179,000,000 acres of vacant, unappropriated and unreserved public lands. Though a mere scattered remnant of the once vast public domain and including mostly lands of rather limited surface value from the standpoint of exploitation, this area is important for various reasons. It has great influence upon one or more of such important matters as watershed efficiency, flood control, wild life, recreation, grazing, or the rounding out of the boundaries of existing reserved areas such as national parks and national forests. Much of it would have considerable commercial value for grazing had it not been allowed to approach ruination through neglect and mismanagement.

In brief, the report recommends general and specific policies that it believes should guide the government's attitude toward the remnant of the public domain. Summed up, the Committee recommends that the government get rid of the entire area except for subsurface mineral rights, areas chiefly suitable for inclusion in national forests, parks, or monuments or for other stated purposes. It suggests that with these reservations the lands be turned over to the states for administration or sale under certain safeguards. Just what interest the states could have in what is left is difficult to see. Those states that believe they have a moral right, if not other rights, to all the public lands within their borders will not be satisfied unless they can have a clear title to subsurface rights

also. They want the apple to go with the core. Some of them will look upon the proposed gift with suspicion and may not at all be willing to accept what appears to them to be a sinking ship. Toward certain areas they feel that the government, having allowed them to go to ruin and become a liability, should at least rehabilitate them before transferring the responsibility of their administration.

The bad features of the report lie not so much in what is actually written into it as in its implications. It is skilfully prepared. The value of the lands for watershed protection is put solely on a basis of engineering works. The local state boards, suggested for determining what is to be added to the national forests from the domain or taken from them and given to the states, will have a working majority of political appointees with merely a local point of view. It is quite possible that in some states these boards would be a step toward disruption of existing national forests. Also, the way is opened for a transfer of the national forests to the Department of the Interior, and the Secretary of Agriculture would likely lose the ability to redeem responsibilities with which he is now charged by long-established federal law.

There is no gainsaying that the remnant public domain needs better administration, but there is at the same time a serious question as to who should provide such administration. The federal government has proved its ability to administer wisely vast bodies of land, once such lands are assigned to a department interested in their care and development. The states, with some exceptions, have failed to show the requisite interest and capacity to handle similar or even better lands. To split up the total area among the 17 states concerned would invite a continuation of the present neglect and wastage on a large portion. Certainly there would be no uniformity of policy or management. Those who believe in federal management feel that if any splitting up is to be done it should be done among federal bureaus competent to handle the lands. The bureau handling them at present is not competent by permissive authority or otherwise to administer them as they should be. It would seem the wiser policy to keep the bulk of the lands under federal administration in appropriate bureaus and thus assure the uniform conservation and management of the resources they contain.

The Committee was authorized on April 10, 1930, and met for the first time the following June. Its report is dated January 16, 1931. Thus after a bare six months of study of a big problem and voluminous data, it feels competent to pass judgment on the future disposition and administration of an area that is not only huge but whose handling has national as well as local aspects. The proposed breaking up of the domain will not satisfy the conservationists, nor is it likely, as to method of disposition, to be attractive to the states. Incidentally, it might be considered significant that the report is not signed by the member of the committee probably most familiar with the situation and most competent to suggest what should be done. In all fairness to the Committee, the report is probably all that could be expected under the circum-

stances, and it serves a good purpose. It brings the subject forcibly before the public and opens it for discussion. From it should result a really logical classification, allocation, and wise administration. Doubtless the next Congress will make its consideration a job of major importance.

Foresters should follow the discussions and proposed legislation with keen interest. Many of the principles for which they have stood for many years will be put to the acid test.

The general policies and special recommendations of the Committee appear on another page in this issue.

CONCERNING THE SIGNIFICANCE OF THE SEED SOURCE OF OUR FOREST TREES

By DR. FRANZ FANKHAUSER

Forest Inspector, Retired, Bern, Switzerland

This excellent article by a Swiss correspondent has been inspired by the reading of American literature depicting reforestation methods in this country, and is offered in a helpful spirit. Although many articles and items regarding the importance of seed source have appeared in the JOURNAL in recent years, it is a subject to which we, in a practical sense, have given all too little consideration. The present article brings home the lesson in a more definite way than do most of the brief items from foreign journals. The author is an honorary member of the Society of American Foresters. Thanks are due to Paul Rudolf of the Lake States Forest Experiment Station for the translation from the German of Dr. Fankhauser.

THANKS to the planting investigations which the forest experiment stations have established, principally during the course of the last 40 to 50 years, it has been brought to our knowledge that when individuals of a plant species, which species occurs both in the mountains and the lowlands, originating in the plains and low hills are planted in the mountains they do not grow as well under these climatic differences as individuals of the plants indigenous there. Inversely plants from high situations planted in the flat lands not only have a much slower growth rate but also exhibit a significantly inferior resistance to plant and animal diseases than those with a provenience[1] from low situations.

In the same manner it was later proved that individuals from northerly regions were not suited for planting under more southerly skies and vice versa.

Indeed, different hereditary varieties of a given species, which have been designated as *climatic races*, consequently originate according to the local climate; which without exhibiting important morphological differences nevertheless deviate quite markedly from each other in physiological respects.

The practical experiences of modern forestry have shown, however, that it is not sufficient for satisfactory results to obtain the plants from approximately the same altitude and only a slightly different geographical latitude. Plantations of Swiss stone pine (*Pinus cembra* L.) which had been established in the Bernese highlands on different sites ranging from 1,800 to 2,000 meters (6,000-6,666 ft.) above sea level and which apparently were thriving quite well for from 15 to 20 years and had reached a height of from 1 to 2 meters, suddenly died out, although the seed used had been collected in the Swiss Alps and also at a high altitude since the stone pine does not occur there under 1,700 to 1,800 meters (5,666-6,000 ft.)

[1]*Provenience* refers to the source of the seed, that is, the locality or province of which the mother tree providing the seed is an inhabitant. *Ed.*

Similar results occured with plantations of mountain pine (*Pinus montana* Mill.) the seed of which had been obtained in the East Alps. They also throve excellently for nearly 20 years; then, however, without externally visible causes they died over an area of several hectares upon connected lands.

However, plants sometimes perish in the lower situations also although they have been obtained in their own region and from an altitude not essentially different. So it was that the drought in the summer of 1911 killed seven-year-old planted spruce (*Picea excelsa* Lk.) not far from Solothurn along the southern border of the Swiss Juras, although their parents had grown in approximately the same altitude and slightly farther east on the Swiss high plateau. In comparison spruce of the local race which had seeded in in the immediate vicinity of the planting site sustained not the slightest damage.

Exactly the same phenomenon occurred last year at Pruntrut, in the northern Bernese Juras, in plants of Scotch pine (*Pinus silvestris* L.).

Also 25-year-old larch (*Larix decidua* Mill.) planted in Unterwallis at 600 meters (2,000 ft.) above sea level, the seed of which had been collected at an altitude of 400 meters (1,333 ft.) and only about one degree of latitude farther north, died in the summer of 1929 as a result of unsuitable provenience.

Numerous other examples of unsuccessful plantations of trees which were not transplanted into a different *general climate*, can be cited. Those which have been mentioned however, may suffice to show that this factor alone (general climate) does not determine the ultimate result, but that the *local climate* besides must also be taken into consideration as a more important factor.

Moreover it is not at all obvious why the soil also, as well as the climate and the situation, should not exert a corresponding effect upon race characteristics, since Professor Dr. Krauss of Tharandt[2] has proved that upon various calcareous soils the beech foliage in the fall contained three times as much calcium as silicon by dry weight, while upon sandy soils the calcium content was only about one-third that of the silicon content. It seems, however, to be of no significance to separate distinct soil races, as has been proposed before, since the soil alone can restrict the development of a race no more than the climate alone. Rather the *total complex of climate, situation, and soil* working together continually exerts its influence, so that individuals less adapted to local conditions remain backward and are extirpated by the natural reproduction. Since this process is repeated continually over a long period of time, there finally arises through this continual selection a physiological variety particularly suited to the locality concerned, a so-called *site race.*

Since the site factors, however, may be combined in unending diversity upon very restricted areas whose orographic and geognostic qualities change markedly, there are not merely a relatively small number of site-races for each tree species, as is usually supposed, but many result, *so that for each forest*

[2]Schwankung des Kalkgehaltes im Buchenlaub. Forstwissenschaflt. Centralblatt. 1926. p. 464.

region the original indigenous race must be that particular one, which in the course of a very long period of time has adapted itself most perfectly to the given local conditions and which therefore prospers better than any other physiological variety introduced from the outside.

The death of the plants, as in the previously mentioned examples, does not necessarily follow the flouting of these principles for the artificial regeneration of the forest. They will, however, be more or less backward in their development. In accordance with the laws of nature the injury to growth will be particularly noticeable where the external conditions are difficult, as for instance in the high situations. It is not to be wondered at, therefore, that the question of provenience, here assumes greater significance than it usually does in the lowlands.

The particular suitability of the old indigenous race for a given site is not expressed in its more vigorous growth only, thanks to which it gains the upper hand and finally occupies the site alone. A similar selection also takes place regarding growth form, since the oppression from the side effected by the closing in of the stand prevents a heavy development of branches and the new woody tissue, which is produced abundantly, is necessarily laid upon the stem to a greater degree. The tree thereby becomes straight, clear-boled, and of good form.

That this idea is no mere hypothesis is proved convincingly by the surpassingly fine stands naturally regenerated many times during the centuries and also by woodlands which have been established with indigenous seed. In this connection we recall those trees, incomparably straight, clear-boled, and of good form in the extensive Bourbon oak woodlands of France and Spessart in northwest Bavaria and also the magnificent firs of the Black Forest and the Emmental hills. (Figs. 1 and 2.)

Furthermore the leaving of a good race has added to the value of many virgin woodlands which have existed for countless thousands of years and in which besides intensive soil improvement, the favorable influence of the locality has produced simultaneously the best developed site-race and the growth-form developed by natural selection.[3] It should not be necessary to cite examples here since the otherwise unattainable perfection and size of the of the virgin forest, as for instance occur in the national forests and national parks of the United States of America, are generally well known through publications and illustrations.

On the other hand, there are still two occurrences to be mentioned which may demonstrate what a contrast regarding tree form results from planting the indigenous race and one from commercial seed perhaps of an introduced foreign variety.

In the Frenois State Forest in the Bernese Juras there is an 80-100-year-old stand of Scotch pine (*Pinus sil-*

[3]It is known that there are also virgin forests which, having existed for a shorter time, fall more or less short of perfection. Poorer, younger soils such as result from landslides, floods, volcanic eruptions, etc., which are constantly breaking out anew, support poor stands in the virgin forest also.

Fig. 3

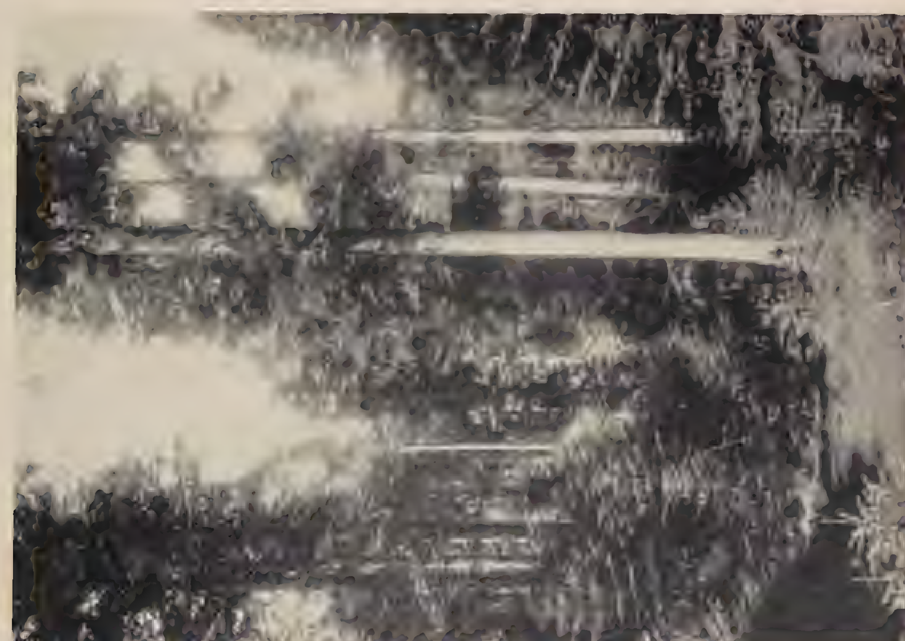

Fig. 4

Fig. 6.

Fig. 5.

Fig. 7

DESCRIPTION OF ILLUSTRATIONS

Fig. 1.—Selection forest of fir and spruce in upper Emmental (Canton Bern).

Fig. 2.—Even-aged stand of beech and fir reproduced naturally since time immemorial in Sircourt Commune (Canton Bern).

Fig. 3.—80-100-year-old Scotch pine naturally seeded-in in the Communal Forest of Bassecourt (Canton Bern).

Fig. 4.—Scotch pine of south German provenience planted from 45 to 50 years ago in the vicinity of the plantation shown in Figure 6.

Fig. 5.—A 50-year-old beech stand of the castle forest of Wildegg (Canton Aargau) established by planting seedlings from a beautiful stand in the same neighborhood.

Fig. 6.—40-year-old planted beech stand in the Commune of Treyvaux (Canton Freidburg), resulting from commercially obtained seed.

Fig. 7.—35-year-old planted Douglas fir which has been pruned three times in Küssnacht Commune (Canton Schwyz).

vestris L.) which seeded in naturally, and which leaves nothing more to be desired regarding straightness, clear length, and good form. (Fig. 3.) On the same slope and at the same altitude, but 400-500 meters (1,333-1,666 ft.) away, stand some Scotch pines, the seed of which was obtained from south Germany, were planted 45-50 years ago, and today because of their heavy branching and poor form they stand as a truly shrieking contrast to the other stand. (Fig. 4.)

Planted beech (*Fagus silvatica* L.) often exhibits similar differences. A 50-year-old stand at Wildegg in Aargau Canton, established by planting seedlings which had been taken up from natural reproduction in the vicinity, exhibited all the characteristics of the beautiful parent stand (Fig. 5), while a slightly younger planted stand in the La Combert State Forest (Freiburg Canton) upon a similar, favorable site, which resulted from seed supplied commercially, had an undesirable stem form which stood out in an unforgettable manner. (Fig. 6.)

Generally it may be said that seed collectors think only of obtaining seed in the greatest quantities with the least trouble and have a predilection for the lower, branchy trees which are easy to climb and thereby likewise provide the poorer growth forms for forest planting. This particular objection holds for the cultivation of Douglas fir in Europe. While they often attain a clear length of 100-200 feet in their natural habitat according to Willis Linn Jepson,[4] in Switzerland they fall down, so to speak, without exception as a result of extraordinary branchiness maintained for a long period even in good dense stands. (Fig. 7.)

Finally there is this advantage which the local indigenous race exhibits in comparison with a foreign one, that is a greater ability to resist destructive external influences.

As is well known the weakly individuals in all states of life are always attacked and culled out by the parasites of the plant and animal kingdoms which is due not only to the inferior resistance which they oppose to the attacks of their enemies but also the circumstances that sickly and weakened organisms offer a particularly favorable medium for the existence and increase of parasites and therefore are particularly sought by them.

In the forest for example we are not unaware of this. We know that many parasitic fungi multiply extremely rapidly upon weakly plants while the bark beetles and other forest-damaging insects, for example, attack healthy trees only in exceptional cases when others are lacking. This preference of the most dangerous insects injurious to the forest, such as many of the caterpillars, for sickly hosts, has to our knowledge not been directly demonstrated, though without a doubt it lies very near the truth, since it has been found that the woodlands of those states in which the clear cutting system and consequent artificial regeneration from seeds of foreign provenience is oldest and most widespread, are afflicted time after time by the ravages of caterpillar damage. Hun-

[4]The Silva of California, p. 114.

dreds of thousands of hectares of apparently promising forest stands have already been desolated by the pine moth (*Gastropacha pini* L.), the nun moth (*Psilura monacha* L.), the pine-looper (*Fidonia piniaria* L.), the pine noctuid (*Trachea piniperda* L.) and others and thereby will bring about damages to the sum of hundreds of millions, while in those places where forest regeneration results chiefly from natural seeding, insect damage occurs scarcely at all, and calamities of large extent are unknown.

The circumstances that virgin forests themselves have sometimes suffered from insect depredations cannot refute the obvious cause of the misfortunes since there are also virgin forests which are still far from a state of perfection with correspondingly inferior resistance.

At any rate the enormous losses brought about by insect attacks will not be put to an end now that the forest can be dusted with the arsenicals from airplanes and all animal life annihilated, for the eradication of the friends as well as the enemies of the plant world will produce further abnormal conditions. In this respect also our foremost principle must be the return to nature.

So we come to the conclusions:

The forest will yield us the greatest and most valuable volume of wood permanently only if we reproduce it by *natural seeding*, or, where this is impossible, if we use in its reëstablishment *seed which has been collected as nearly as possible in the vicinity of the planting site.*

A NEW PRINCIPLE IN SEED COLLECTING FOR NORWAY PINE

By C. G. BATES

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This study, which is a by-product of a long-term study involving the growing of Norway pine progeny from different localities and individual trees within the natural range of this species, is still not a genetical study in the true sense. It involves only the question of immediate vigor and survival in nursery stock and points the way to obtaining the best seed from this standpoint only. Nothing in these results is intended to suggest that the geographic origin and climatic adaptation of different strains are not important in reforestation,—rather that, within a given locality or range, certain types of trees are much more efficient seed-bearers than others.

NEARLY every forester has had occasional opportunity to observe the prolific seed-production of an individual tree, injured or extremely senile and perhaps on the brink of death. This has often been described as nature's provision for giving the dying tree one last and magnificent opportunity to reproduce itself. In the nature of things, there must be a physiological explanation for such a reaction, and the possibility of increasing fecundity at the expense of vegetative growth by girdling a tree, as has been done at least with fruits, suggests strongly that the explanation is to be found in the distribution or quality of the food supply as affected directly by the injury or by the inhibition of vegetative growth.

Again, it is known to be fairly common with trees that the first seed borne may be entirely or nearly sterile and that quality of seed generally improves with the advance in age. Obviously this relationship should also be explained through the nutrition of the tree, since there is no good reason for assuming imperfect inflorescences or failure to pollinate in young trees.

This paper presents the thesis that the strength of Norway pine (*Pinus resinosa* Ait.) seeds and the immediate vigor and hardiness of seedlings developing therefrom vary inversely as the vegetative vigor of the parent trees, and that in consequence the most profitable seed collections, from the standpoint of nursery production solely, and without regard for hereditary tendencies which may develop later, are to be made by avoiding particularly thrifty parent trees, and especially, vigorously growing young trees on the best soils. Whether inhibition of vegetative vigor in the parent trees comes as a result of advanced age, competition of other trees, poor soil, lack of moisture, deterioration of the soil due to fires (usually accompanied at least by stem injury), or other injuries such as root curtailment, it will generally be found that the seed produced by slow-growing trees is of an entirely different physical quality, better-filled and nourished, and superior in every way to that from very vigorous trees. The superior seed, however, quite often has the characteristic of a definite dormant period after maturation and seems to require careful after-ripening.

As stated above, this thesis is disconnected from hereditary tendencies which might develop in different progenies after the seedling stage. Except in the case of reduced vigor resulting from disease, the tendency toward which is likely to prove hereditary, the suggestions which arise from the present discussion are not, it is believed, likely to be found in conflict with the best practice as seen by the geneticist. They are, truly, somewhat in conflict with the theory that seed should not be collected from trees stunted by poor soils or unfavorable climatic conditions, a theory which has not been adequately proven and probably is not tenable, at least if the progency are to be grown under similar conditions.

It is desirable to make clear also at this point that the discussion has little to do with *quantity production* by trees in different conditions of growth. While some quantitative data will be introduced, it is primarily with the *quality of seed vigor* that we are concerned.

In a review of the subject, it is found difficult to separate entirely those views which have a bearing on the present thesis from those which refer to genetical considerations, and also, the terminology of seed production may often be interpreted as referring either to quantity or quality.

Review of the Situation

The prevailing opinion among foresters seems to be that thrifty, middle-aged trees are the best seed-producers, and that in old age the power to produce strong, vigorous seed is in some degree lost. Especially has the idea of *thrift* and *vigor* in the mother-tree been emphasized by geneticists and all those interested in improving the quality of planting stock by careful selection of the seed. The present writer has fallen into this error (2) although questioning whether selection should be especially directed towards developing a strain of fast-growing trees.

Thus, Bagneris (1) says, "Thus those trees ought to be preferred, which are completely fertile, and at the same time sound and vigorous. Very young trees furnish many barren seeds, while very old ones yield seeds which produce weak plants."

Toumey (8) quotes Zederbauer as having shown that seed collected from suppressed or sub-dominant trees produce plants less resistant to disease than seed collected from dominant trees. Also, he states, "When the poor form of the mother tree is due to weather effect or damage by man or beast, it is not carried over into the next generation through the seed. Poor growth and form, however, due to poor soil and climate, is transmitted through the seed." Again: "Wide-crowned, short-boled thrifty trees growing in the open are usually very prolific seed bearers. As they owe their unsatisfactory form wholly to the light conditions under which they grow, and not to inherent characteristics, seed from them is equally as good as that collected from trees of suporior quality in commercial stands." This is apparently inconsistent in principle with the next preceding quotation, for light is a "climatic" factor. The probable distinction is that an entire race of trees does not develop under either extreme of light; hence,

that this factor must have less effect than those which affect all trees in a stand or locality.

Moon and Brown (5) reiterate the common belief that "Trees in middle life produce the best seed; also those that have had good light in youth."

Pearson (6) in part controverted the last-mentioned idea as applied to western yellow pine by showing that large *mature* trees were so superior to younger trees in quantity production as to justify leaving for seeding purposes two or three of these old trees per acre, in spite of the immediate stumpage sacrifice, and this idea has been quite generally accepted in Forest Service timber sales throughout the range of western yellow pine. Pearson (by rather meager tests, to be sure), showed that the germinative quality of seed from the old trees was not in any sense inferior to that of young trees, and his heaviest seed (number per pound, class averages) came from the largest of the mature trees and from suppressed trees. Moreover, he found that light mistletoe infection did not reduce seed production but that, in fact, the heaviest yield of viable seeds per tree was obtained from a group of eight such trees with an average diameter of 27 inches.

In the case of lodgepole pine, seed production studies extending over 10-year periods showed that a fair quantity of seed was produced by trees of the intermediate height class in crowded and essentially even-aged stands, and that while this seed was less in amount than that from the dominant trees, it was by no means inferior in germination. In fact, the lowest average germination tended to appear in the larger collections from the most vigorous trees.

An additional result of this study which may have a bearing here, and which was originally ascribed solely to climatic differences between the two regions, was that the seed from the Gunnison National Forest always showed higher germination and a more vigorous germination curve than that from the more northern Medicine Bow National Forest. The stands in the former locality were characterized by such density and evenness of competition that there were no truly dominant thrifty trees, while in the latter case the stand was relatively open and the differentiation much more distinct.

Extensive confirmatory evidence that neither the quantity nor quality of seed is necessarily highest in "thrifty middle-aged trees" is not readily available in dependable form. One unrecorded instance comes to the writer's mind, however, in the case of Douglas fir involved in a "selection" experiment at the Rocky Mountain Forest Experiment Station, where seed from an old, stunted and extremely limby tree was greatly superior both in quantity and productivity to that from a paired tree growing nearby, which was of about the same size but younger and in every sense "normal." Both were open-grown and the stunted character of the one found no adequate explanation in the growing conditions, except that it had doubtless survived one or more fires.

Regarding Norway pine there appears to be little or no information, despite the fact that thousands of pounds of seed of this species are collected every year when the crop will permit.

and that the seed is in great demand. Woolsey and Chapman (9) state, "Trees in the open have produced good cones when 25 years old, and in stands when from 50 to 60 years old. It is not known definitely when seed production begins to fail in old stands, but probably the fertility and quantity begin to fall off when the trees reach an age of 150 years." While it is apparently true that old virgin trees do not bear cones like young trees, (that is, in some degree nearly every year), but tend to respond more definitely to the so-called "cycles," it is believed there is little ground for the supposition that old trees "fail in seed production" or that their seed is in any degree inferior to that of middle-aged or young trees.

Richardson (7), in describing the operations incident to a large seed collection in Ontario, has only this to say on the source of the cones, "The . . . . country is composed of a sand plain from which the pine, both red and white, was removed 40 to 50 years ago. Today a great deal of it is treeless barrens with here and there clumps of red pine 30 to 40 years of age, widely scattered, with large rounded crowns, the ideal form for cone production." The seed from such young, open-grown trees does seem to be capable of good immediate germination, and the average of 87 samples from these collections showed a high value, 87.12 per cent germination, and 50,624 seeds per pound, which is certainly not light for northern seed. However, this last figure may be meaningless, for the tendency toward chaffiness in seed can be largely eliminated by fanning. Moreover, germination alone does not tell the whole story which is of interest here.

The Data

The results here reported have been obtained in connection with a breeding study of Norway pine, in which 41 lots of seed of the 1927 and 1928 crops were sown in the Cass Lake Nursery in the spring of 1929. Only sufficient seed of each lot was sown to produce from 500 to 1,000 seedlings, or even less where the quantity of seed available was very small. In the case of the regular 500-tree lots, the seed was sown in three separate drills in different parts of the three beds employed, which were side by side and had an average length of about 32 feet. Larger and smaller lots were distributed in proportionate numbers of row units. The number of seed sown in each row was based on greenhouse germination tests which had been rather erratic.

Owing to the fact that nursery germination was not at all in agreement with greenhouse germination, and that losses in the nursery had in a few cases been heavy before that date, the seedling rows were thinned on August 31, 1929, in each instance where the number per row exceeded 130. Then, as the winter was unfriendly, with inadequate snow cover and ice forming on the beds in February, rather severe winter losses were entailed. It was, therefore, decided to further equalize growing conditions in the nursery by transplanting all of the survivors in the spring of 1930. The seedlings from the three rows of each lot were assembled, then re-distributed in from 5 to 11 trans-

plant rows, as their number required, these again being scattered over two beds 90 feet long. By these two scattering processes, it has been assured that the seedlings and transplants of any particular lot have been subjected to practically the same average growing conditions as all other lots. (The same plan will be followed in the field planting.)

The summer of 1930 in the transplant beds was not an easy one, owing to the drought conditions. While the beds were well watered, there was one section, representing neither the first nor last transplanting, which suffered especially heavy losses apparently because of unfavorable soil conditions and a dry atmosphere during transplanting. However, a good share of the summer losses are probably to be looked upon as extensions of the winter injury. This is the case because at the time of transplanting every seedling was saved which appeared to have a chance, and many, which were classed among the living at that time, were undoubtedly practically dead.

Therefore, while survivals as seedlings (from the time of the highest count of each seedling row, giving the "germination" figures, to the spring of 1930) are computed separately from the survivals in the transplant beds, it is doubtful if the two items have any separate significance. In these computations, the numbers thinned out at the end of 1929 and the few live trees discarded in transplanting are, of course, taken into account.

A part of the data here reported, resulting from a test of the "hardiness" of the different seed stocks when grown and exposed entirely under artificial conditions, were discussed by the present writer about a year ago. (4). They are brought into this discussion first because they show at least a generic connection between the artificial tests and the survivals under nursery conditions, and secondly because it is now possible to offer some sort of explanation of the apparent vagaries of the stocks grown under artificial conditions, namely that their behavior was affected by differences in the characteristics of the parent trees quite as much as or more than by the geographic origins of the trees and the climatic conditions under which they were severally grown.

The data on greenhouse and nursery germination, and also those on weight of seedlings have also been reported in Technical Leaflet No. 19, of the Lake States Forest Experiment Station. Owing to errors which were not discovered until later, however, the figures now given will not be found to correspond exactly. For consistency, the same geographic grouping is used as formerly, although this might be improved upon.

All of the basic data are given in Table 1.

1. Group 1 is characterized by subnormal germination both in greenhouse and nursery (about normal ratio between the two). In spite of this, the production of transplants from seed, 23.4 per cent, is slightly above the general average, and that from seedlings, 55.9 per cent appreciably so, the latter being exceeded by no other group. The four lots in this group show fair consistency in survival of seedlings. Except for Lot 22 (22-year-old planted trees of fair vigor, origin of stock unknown),

TABLE 1

VARIOUS MEASURES OF HARDINESS AND STRENGTH IN THE SEEDLINGS FROM 41 LOTS OF NORWAY PINE SEED, SOWN 1929

Geographic group	Lot Number	Number sown in of seeds Nursery	Germination G. H.[4] percent	Germination Nursery percent	Germination Nursery Number[1]	Number of seedlings spring 1930[2]	percent Seedling survival	Number fall 1930 of transplants	Transplants percent survival	Combined survival % from seed sown	Combined survival % from seedlings started	Top weight seedlings fall 1929 mgs.	Freezing test survival percent[5]
1	20	1074	40	56.0	602—552	369	66.9	277	77.2	28.9	51.6	31	100
Upper	21	837	54	51.1	428—381	296	77.7	145	49.0	19.5	38.1	44	
Peninsula	22	347	96	54.2	188	150	79.8	121	80.7	34.9	64.4		
Michigan	23	305	38	15.1	46	35	76.1	32	91.4	10.5	69.5		
Group averages			57.0	44.10			75.12		74.58	23.45	55.90	37.5	100
2	26	617	81	58.6	362—359	265	73.8	135	51.0	22.0	37.6	44	
Northeastern	27	1000	50	54.7	547—429	349	81.4	205	58.8	26.2	47.8	37	25
Minnesota	28	1190	42	49.3	587—477	341	71.5	194	56.9	20.0	40.7	42	50
	34	1316	76	60.3	794—761	390	51.3	137	35.1	10.9	18.0	40	0
	35	1309	32	18.1	237	180	76.0	141	78.4	10.8	59.6		80
	36	862	58	20.5	177	109	61.6	71	65.2	8.2	40.1		
	37	544	92	43.8	238	174	73.1	104	59.8	19.1	43.7	46[3]	
	38	694	72	33.7	234	166	70.9	120	72.3	17.3	51.2		75
Group averages			62.9	42.38			69.95		59.69	16.81	42.34	41.8	38
3	11	676	74	57.9	391—373	311	83.4	225	72.4	34.9	60.4	52	
Northwestern	12	694	72	46.7	324	287	88.6	230	80.2	33.1	71.0		20
Wisconsin	13	1492	67	55.8	832—745	442	59.4	212	48.0	15.9	28.5	52	
	14	781	64	34.1	266	207	77.8	153	73.9	19.6	57.5		100
	46	1560	32	58.6	914—640	322	50.3	211	65.6	19.3	33.0	32	0
	47	676	74	40.7	275—268	246	91.8	205	83.4	31.2	76.5	59	92
	48	1666	20	24.2	403—366	245	66.9	204	83.3	13.5	55.7	40	25
	49	1000	50	61.6	616—477	369	77.4	263	71.3	34.0	55.1	41	17
	24	714	70	61.5	439—352	288	81.8	134	46.5	23.4	38.0	43	
Group averages			58.1	49.01			75.27		69.40	24.99	52.96	45.6	50

4 Lower Michigan	19	2040	49	43.7	892—822	548—480	66.7	273	56.9	16.6	37.9	47	0
	29	1110	58	37.2	413—365	239	65.5	90	37.6	9.2	24.6	48	25
	30	981	52	40.6	398	307	77.1	104	33.9	10.6	26.1		0
	31	2083	24	24.0	501—449	245	54.6	140	57.2	7.5	31.2	54	
	54	521	96	56.5	294	226	76.9	130	57.5	25.0	44.2		0
	80	694	72	61.7	428—402	344	85.6	156	45.3	23.9	38.8	50	0
	81	758	66	47.5	360	333	92.5	166	49.8	21.9	46.1		0
	82	714	70	52.0	371	308	83.0	185	60.0	25.9	49.8	42[3]	0
	87	641	78	54.0	346	258	74.5	216	83.8	33.7	62.4		0
Group averages			62.8	46.36			75.16		53.56	19.37	40.12	48.2	3
5 Central Wisconsin and Minnesota	15	1818	61	49.0	891—786	513	65.3	316	61.6	19.7	40.2	54	0
	17	1041	48	47.5	495—412	288	69.9	247	85.8	28.5	60.0	51	0
	18	1087	46	59.6	648—427	354	83.0	286	80.8	40.0	67.0	55	
	60	337	48	69.5	234—190	136	71.6	121	89.0	44.3	63.7	56	67
	61	1428	40	25.1	358—325	208—205	64.0	142	69.3	11.1	44.4	46	33
	64	781	64	66.8	522—427	316	74.0	225	71.3	35.2	52.7	69	0
	74	1042	96	54.1	564	354	62.8	180	50.9	17.3	32.0	42[3]	0
	75	704	71	77.6	546—417	376	90.2	298	79.3	55.4	71.5	51	33
	76	610	82	46.3	282	236	83.7	164	69.5	26.9	58.1		
Group averages			61.8	55.06			73.83		73.06	30.93	54.40	53.0	15
6 New Hampshire	78	1428	70(e)	68.2	974—789	544—528	69.0	155	29.4	13.8	20.3		
	79	1250	80	65.0	812—762	536—528	70.3	217	41.1	18.8	28.9		0
Group averages			75.0	66.6			69.65		35.25	16.30	24.60		0
General averages			61.59	48.84			73.60		63.67	22.89	47.27	47.0	25

[1]The second figure in this column indicates the reduction by thinning on August 30, 1929, and therefore the number on which seedling survival percentage should be computed.

[2]Based on the number actually transplanted. Where two figures are given, it means that live seedlings were discarded at time of transplanting, the second being the figure on which transplant survival should be computed.

[3]Seedlings cut off by grubs prior to August 30, 1929, considered as dying of natural causes. Possibly less mature than those cut August 30 for samples during process of thinning.

[4]In a number of cases two germination tests were made, the higher and usually the later figure being used in each case since it is believed the better germination denotes after-ripening which would be effective upon the nursery sowings.

[5]The group averages are weighted for numbers of seedlings in the several tests.

the Upper Peninsula material is from fairly old, unthrifty trees growing on light, poor sands characterized, like many of the Upper Peninsula soils, by a superabundance of iron. This characterization is especially fitting for Lot 20, whose nursery performance is nearly average, and whose seedlings withstood the artificial freezing test so completely as particularly to call attention to this region.

2. The second group, representing northeastern Minnesota (from Virginia to Ely), stands out in the nursery tests, as it did in the freezing test, as very markedly inferior to both Upper Peninsula and northwest Wisconsin. The group shows the lowest nursery germination and ratio of nursery to greenhouse germination, and it is for this reason that the final survivals based on seed are so low, only one lot equaling the averages for groups 1 and 3. However, both seedling and transplant survivals were also below average.

In attempting to explain the sharp difference in the freezing test between Lots 34 and 35, we have stumbled upon the first evidence which explains plausibly this generally low regional showing and which gives ground for the main theme of this paper. Because of the striking difference between the two trees from which Collections 34 and 35 were taken, and to make certain of precenting a clear picture of this difference, they are illustrated in Figure 1. It will be noted that they are only a few feet apart. When measured in 1928, Tree 34 was 48 years old, 45 feet high, and 14.0 inches d. b. h., while Tree 35 was 46 years old, 50 feet high, and 12.5 inches d. b. h. The more slender character of Tree 35 may be due in part to the fact that it is almost on the top of a rocky knoll, while No. 34 is in better soil at its edge, but is probably due to the fact that No. 35 has been more crowded not only by the small white pine beside it but apparently by other trees which have been cut. The lean of the tree also suggests broken roots. The present and important difference between the two trees is indicated by the much heavier, thicker crown of No. 34.

In the nursery the germination of the seed of Lot 34 was much higher than that of No. 35, as it had been in two greenhouse tests, in which the two lots, from November 1928 to April 1929 stepped up from 60 per cent to 76 per cent and from 8 per cent to 32 per cent, respectively. These relations tend to indicate that in the fall after collection the seed of Lot 35 was much more in a state of dormancy than the other, and that this condition had been partly altered when the nursery sowing was made about June 1.

Both in seedling and transplant *survival* Lot 35 was much superior to No. 34, with final results at the end of the second year almost identical. In short, Lot 35 is of a type which gave low germination and high survival. This tends to suggest that Lot 34, while having the appearance of greater seed strength, produced a great number of weak seedlings.

3. To depart from this single example and at the same time consider another situation which at the time of the freezing tests was outstanding enough to cause remark, Group 5, which represents trees found toward the

Fig. 1.—Strikingly different seed trees. Thin-crowned, slightly crowded, and leaning Norway pine, from which Collection 35 was taken, at left, and at right fairly heavy "vegetative" type for Collection 34. See text.

Fig. 2.—Cone samples showing difference in solidity and nutrition of cones from thrifty and unthrifty trees, Norway pine. C-75, young tree recovering its vigor after root injury; C-148, thin-crowned tree growing on rocks; C-169, mature trees; C-170, fire-repressed tree; C-171, strongly vegetative "orchard" type; C-218, moderately vigorous Michigan form. November, 1930, about 1 month after collection of cones.

Fig. 3.—Most of seed collection No. 60 came from control tree of the three growing on top of sandstone ledge, at Kilbourn, Wisconsin. Age 65 years.

Fig. 4.—More retentive soils in vicinity of Kilbourn may produce the extremely heavy vegetative type of tree. Age 61 years.

southern border of the Norway pine range in a diagonal line across Wisconsin and Minnesota, should next be considered. In the case of Lot 60 of this group, it was noted that one pot of four seedlings showed very great resistance to freezing, while another of two seedlings succumbed to the same treatment. The combined results, 67 per cent survival, were so far above the general showing of the southern seed as to make this Lot outstanding, although Lot 61 gave 2 hardy seedlings out of 6, and Lot 64 none. The best possible explanation of this variation which can now be offered is that Lot 60 was made up largely of the seed from one thin-crowned tree growing on a rocky ledge, although there were others from which a few cones were taken which might well be classed as moderately "vegetative." By comparison with Lots 61 and 64, the general average of vegetative vigor for Lot 60 must be considered very low, however. The nursery performance of these three lots is not entirely consistent although Lot 60 stands well above Nos. 61 and 64 both in seedling survival and production from seed. On the basis of tree appearance we should have expected Lot 64 to show greater weakness than No. 61. But the latter showed more markedly the "immature cone" characteristic which will be described later.

Turning to Lots 74 and 75, which represent nearly paired trees in another locality, it is to be noted that No. 74 is a strong, full-crowned open-grown tree, while 75, though young, had probably suffered root injury from cultivation around it and appeared to be "on its last legs" when the heavy seed crop of 1928 was borne. In June, 1929, it was nearly dead, but it has now recovered as the result of special care. The seed of Lot 75 was another example of unreadiness to germinate when first tested; it gave no germination until nearly 100 days after sowing, and then only 20 per cent. Tested in April, it germinated 71 per cent, and its nursery germination was nearly 78 per cent. The seedling survival from this lot was extraordinarily high and its final showing more than three times as good as that of Lot 74.

We now have an explanation of the wide discrepancies which occur in the nursery results for the geographic groups as found in Table 1, and have introduced certain considerations which raise a question as to whether the apparent differences in hardiness of the geographic groups have any potent meaning in the sense of expressing *regional hardiness.* It is fairly obvious, merely on the face of the table, that we might select individual samples to represent each region, any one of which might measure up to the average standard of 47 per cent seedling survival, or 23 per cent production of 2-year transplants from seed, except in the case of Group 6 where there are only two samples. The question then is not one of the statistical significance of the different averages—although that may be a means of evaluating averages — but rather whether or not certain tendencies toward a definite type of vegetative development *prevail* in each region.

With the exception of Groups 4 and 6, in which the writer is not personally familiar with the seed trees, it is be-

lieved that it may safely be said that the tabular averages and the relative values do represent certain definite tendencies and reflect certain conditions of growth, which are typical of their regions. That these growth tendencies may not be later reflected in significant hereditary tendencies of the progeny is more or less obvious.

Thus, as already mentioned, Norway pine in the Upper Peninsula of Michigan grows rather typically on poor sands heavily charged with iron (occurring in lumps and sometimes called "bog iron", which not infrequently forms a more or less definite hardpan). As a result the trees are often small and stunted and possess low vegetative vigor, but the power, apparently, to produce strong seed and sturdy seedlings.

In contrast, northeastern Minnesota is a region with soils generally "too good" for Norway pine. It is a region which in general tends toward a spruce type as the climax. While there are many local exceptions to this rule, and some sands which might be held permanently by Norway and jack pine, in general it can be said that the Norway which does occur is growing in soil conditions which should tend to produce vigorous vegetation. It is barely possible that this is augmented by the moist condition of the atmosphere near Lake Superior, a condition which is very noticeable within a belt 8 to 10 miles wide, and probably effective much further back. In view of these circumstances, it is not surprising to find that both the seedling and transplant survivals in this group are low on the average, and when combined with the low germination of the seed, give the poorest showing of any of the groups except the Northeast, Group 6. Lot 27, showing the highest final result, was taken from the light soil of a granitic formation on the north shore of Embarrass Lake, though even here there are some trees of the heavy vegetative type. Lot 38 is from a badly fire-scarred tree and it is certain that the vigor of both Nos. 37 and 38 has been somewhat reduced by one or more ground fires during their lives. The peculiar situation of Nos. 34 and 35 has already been discussed. The poor showing of Lot 36 is not readily explained, it being plainly an unthrifty tree, but one growing on a rather heavy soil type.

Region 3, which next to the Upper Peninsula of Michigan has shown a tendency to produce strong seedlings both in the nursery and in the freezing tests, must be explained on a somewhat different basis. The soils of this region do not appear to be intrinsically as poor as the sands of the Upper Peninsula, and in fact in the Wisconsin area, from Woodruff north and westward to Ashland, Norway occurs generally on soils suited to the growth of aspen. It is believed to be true, however, that these areas have been repeatedly burned and the vigor of the pine kept down thereby. This certainly applies to the five collections from the vicinity of Ashland, Nos. 24, 46, 47, 48 and 49. It probably does not account for the good showing of Nos. 11, 12 and 13 from a protected grove near Woodruff, but here the keen competition is enough to explain the suppression of vegetative vigor. Of these three collections, No. 13 with the poorest seedling survival and production

from seeds sown has felt suppression the least, being of largest diameter at the uniform age of 76-77 years. Collection 14 is from the banks of Trout Lake, nearby.

If now the collections from the southern border of the range (Group 5) also give a good account of themselves with especially good nursery germination relative to their potential values, and also with good seedling and transplant survivals, the result can perhaps be accounted for in part by the greater size and possible strength of the seed produced under warmer climatic conditions, but it is believed the physical conditions of growth and the resultant modified vegetative vigor of the trees tend also in the same direction. It is certainly true that the outliers of Norway pine, occurring only where sandstone outcrops or very sandy soils seem to offer some compensation for the climatic complex, are generally rather definitely stunted. While this is not the correct characterization for all the collections in Group 5, there is sufficient admixture of this element to have its effect. In the later collections from this region, especial care has been used to have both the extremely inhibited type and the more vigorous vegetative types clearly represented so that the true effect of regional factors can be more definitely determined.

What then can be said as to the nursery showing of this considerable assortment of seed collections? Obviously, that individual differences of development of the parent trees have a much more important effect in this early stage of development than the general climatic factors of the different localities represented, although these, too, are reflected to some extent in the group averages.

Such being the case, it is important to make perfectly clear what these individual differences consist of.

Primarily the differences seem to hinge upon vegetative vigor in the seed-producing trees, as exhibited in the length of needles, density of the crown and current rate of growth in height and diameter, all characteristics which are readily discernible to the trained eye. Typically we should choose as *the poorest possible seed producer* the tree 40-50 years old, and around twelve inches in diameter, which *is just reaching the peak of its vegetative development.* Whether or not this is "middle age" in the sense implied in the above citations, it is difficult to say, but it is obvious that trees which have grown under moderately free conditions for development will begin to show a decline in vigor soon after the age of 50 has been reached, while trees in more crowded stands will reach a corresponding size much later in life, and may be in the stage of most active growth only after they have attained a position of dominance in the stand.

The vigorous "vegetative" tree will possess very dense foliage, the maximum of limb-length and diameter (since it has been subjected to little or no pruning) and, of course, a crown which is wide, deep and heavy. Although it may be bearing cones quite prolifically (some trees will bear none), there is something about the appearance of the cones themselves which brand them as undesirable. They are more or less "stuffed in" among the

needles of the rapidly-extending branch ends, and in the fall, when they should be mature, they still partake of the verdure of the tree in contrast to the deep purple coloring of well-matured cones. After the first heavy frosts, however, they dry, turn to a pale buff or straw color, and open quickly, scattering their seeds while well-ripened cones still remain firm, damp and closed. Cones on vegetative trees are much more subject to weevil damage than those on thin-crowned trees, a fact which might result either from a difference in succulence and food value, or from the protection afforded the egg-laying adults by the heavy foliage. Birds of the cross-bill and jay tribes readily turn to the vegetative type of tree to obtain the seeds from the partially opened cones, while red squirrels, in localities where there is a choice of foods, as carefully shun them. There are two possible explanations for this,—that the heavy foliage makes it difficult for the squirrels to cut the cones without first having cut off the twigs behind them, and that the squirrels much prefer the type of cones which do not open readily and make their seeds available to the mice. As the theft by mice seems to be the prime factor in causing the red squirrel to cover his cones after they have dropped to the ground, it is a safe assumption that the danger of loss to mice is given some consideration in selecting the cones to be cut. Whether or not the squirrel may also avoid the light, easily opened cones because their seeds are less palatable or nutritious can not be adduced so long as these other factors have to be considered, although the greater tendency to pitchiness in the poorly matured cones would certainly be a deterrent.

The cones from "vegetative" trees are much more difficult to pick than are the "ripe" cones from less vigorous trees, the stems being tough and usually bringing with them, when sufficiently forced, a strip of the parent branch. This immaturity of the tissues shows its effect also in the way in which the partly-opened cones respond to the heat of the extracting chamber. As they continue to dry rapidly after plucking, without opening their scales sufficiently to release the seed, there is very little moisture left in them by the time they would normally be extracted. Consequently they can usually be opened only after being wetted one or more times, each application of moisture and subsequent drying causing the scales to spread somewhat farther. In contrast, good moist cones, such as the squirrels commonly store, will retain sufficient moisture, even after two or three months in sacks, to effect this opening when they are first heated.

The poorly ripened cones show somewhat the same characteristics when they remain on the tree, and it is only as a result of repeated wettings and dryings in the warm air of the spring and summer following their maturation that they eventually become fully opened.

Although the cones from young vigorous trees are frequently very disappointing in their seed yield, and produce many hollow ones which are fanned out, it is impossible generally to bring this charge against the large, plump cones which are produced at early to middle age by the vegetative type of tree. In

order to obtain as fair a comparison on this point as is possible with the data available, and at the same time to summarize the comparisons between the two types of trees which were made for specific cases in the early part of this discussion, the data for seven paired collections are given in Table 2. Of each pair one member is a considerably stronger vegetative tree than the other. Of the Michigan numbers, Collections 80 and 81, the former represents a group of 4 old trees, and the latter three comparatively young ones, this being the only distinction known to exist.

Following the comparisons through Table 2, it is seen that there is no great difference in the dry weight of cones, the noticeably smaller size from non-vegetative trees probably being counterbalanced to some extent by greater solidity, yet the other group runs consistently heavier in the few examples that can be given. The number of solid seeds per cone is greater in the group with the smaller cones, although it would possibly be not much greater if the 1928 data for Lot 60 were used instead of those for the somewhat better cones produced in 1930. Let us say, then, that there is no essential difference in the number of good seeds. On the other hand, the smaller cones produce rather generally a larger percentage of hollow seeds, the 1928 figure for Lot 60 being especially bad, while the 1930 cones of this crop were only 15 per cent hollow. The weights of the seeds from the smaller, sounder cones are greater, though the difference is probably not significant, especially as this is true in only 4 of the 7 pairs. It is really not until we come to the germination figures that anything very significant is noticed. The low germination of the seed from the more solid, better-ripened cones, when tested soon after extraction, is outstanding. This difference tends to disappear,—in a somewhat different set of comparisons, but also in each case tested at both periods,—after the seed had been stored several months at low temperatures.[1] Then, in the nursery sowing, the germination of seeds from retarded or non-vegetative trees comes out sufficiently ahead of the other group to show that its previous performance represented merely a condition of dormancy or incomplete after-ripening, so that in fact most of the units of this group made a better showing in the nursery than they had even late in the winter under testing conditions. Following the matter further, it is seen that survival through the first and second years, of the germinated seedlings of non-vegetative trees, was half again as good as that of the progeny of vegetative trees, and this combined with the better germination gives nearly a two-to-one ratio in the final production from a given number of seeds.

Summary and Conclusions

1. Following 41 lots of seedlings through one year in nursery seed-beds and one year in transplant beds, during

[1]With 13 lots of cones collected between September 20 and 30, 1930, and stored after October 1 at 50°F., then extracted about January 1, 1931, these differences were not discernible, and in fact, the 4 lots of seed from non-vegetative types gave consistently high germination, whereas the median and vegetative groups contained one or more slow-germinating lots. Whether this resulted from the low temperature treatment of the fresh cones, or from the growing conditions of the warm summer of 1930, it is difficult to state.

TABLE 2.

SUMMARY OF CONE, SEED AND NURSERY-SURVIVAL DATA FOR SEVEN PAIRS OF NON-VEGETATIVE AND VEGETATIVE TREES

(Pairing in each locality indicated by nearness of Lot numbers except for 46 and 24.)

	Collection Number	Dry weight per cone grams	Number of heavy seeds per cone	Light seed per cent	Weight seeds per 1,000 grams	Germination Nov. per cent	Germination April per cent	Nursery germination per cent	Seedling survival per cent	Production from seed per cent
Non-vegetative types	11	......	29.20	7.4	8.56	74	—	57.9	60.4	34.9
	20	4.12 (e)	12.86 (e)	26.6	7.59	34	40	56.0	51.6	28.9
	35	5.71	17.75	14.5	7.93	8	32	18.1	59.6	10.8
	46	5.63	13.51	53.0	7.63	28	32	58.6	33.0	19.3
	75	5.98	16.07	5.7	9.94	20	71	77.6	71.5	55.4
	60	5.26 (e)	28.70 (e)	91.7	9.58	5	48	69.5	63.7	44.3
	80	5.56	6.68	17.8	8.16	—	72	61.7	38.8	23.9
Average		5.38	17.82	31.0	8.48	28	49	57.1	54.1	31.1
Vegetative type	13	......	36.65	7.7	8.05	67	—	55.8	28.5	15.9
	21	5.00 (e)	20.20 (e)	23.7	7.25	36	54	51.1	38.1	19.5
	34	6.38	22.77	11.4	8.27	60	76	60.3	18.0	10.9
	24	5.64	13.51	11.1	7.78	70	—	61.5	38.0	23.4
	74	6.63	11.19	5.1	9.28	58	96	54.1	32.0	17.3
	61	7.84	7.55	36.7	9.17	40	30	25.1	44.4	11.1
	81	6.73	7.06	13.6	8.32	—	66	47.5	46.1	21.9
Average		6.37	16.99	15.6	8.30	55	64	50.8	35.0	17.1

(e) From 1930 data, since number cones not counted 1928. The qualities in the two years are apparently very similar, except that C-60 probably yielded better cones in 1930.

each of which periods they were subjected to rather severe weather conditions, brought out great variations in the productivity of various seed lots, the number of survivors being from 8 per cent to 55 per cent of the numbers of seeds sown. Such variation in the productivity of seed is of sufficient practical importance in nursery work to justify a close examination of causes.

2. With 8 or 9 seed collections for each of four regions, and smaller numbers in two other groups, the regional averages of nursery germination and survival show some differences which, while needing better substantiation, are at least suggestive of the desirability of one region over another for obtaining seed of the greatest possible vigor. The wide variations between different seed lots from the same region, however, suggest that such "hardiness" as is shown is not the general result of the climatic complex of each region, and that it may not, therefore, particularly affect the use of the seed from one region in any of the other regions. Final decision on this point must await much longer observation of the progeny when planted out in different regions. The striking variations in quality of seedlings from a given locality but from different trees indicate plainly that the conditions of growth of the individual tree may determine largely what that tree is able to hand on to its progeny in the way of original vigor, a heritage which may or may not be of importance beyond the nursery stage of development.

3. Deriving the conclusions, then, from the comparison of individuals growing practically side by side in each of the several regions, it is found that strong, vigorously growing, comparatively young trees (conveniently called "vegetative") produce generally weaker seed and seedlings than trees of the same or greater age whose vigor has been reduced by any one of a number of causes. The strong produce weak and the weak produce strong progeny, at least in the sense of early survival. This is the point on which the present observations appear to be in conflict with general theory. What this means in the physiological sense is probably merely that, while the tree and its surroundings are in such a status as to permit and encourage rapid growth in the parent tree, either the foods produced by the tree itself or the mineral elements derived from the soil are not available in sufficient quantities to produce good strong seed, or are diverted more readily into the channels where they supply vegetative tissues, which really amounts to the same thing. Without chemical studies to show what elements are lacking in the so-called weak seed, only a very general hypothesis as to the physiological causes can be put forward.

4. The evidence points clearly enough to the general or external causes so that the type of tree which will produce desirable seed is readily recognized, and it is also quite possible to distinguish the cones of the two types after they are picked. In general terms, trees with thin crowns produce desirable seed and those with large and heavy crowns the undesirable form. Except that trees which are prey to any specific disease should be avoided in any case, it is not believed that the taking of seeds from trees of less than average

vegetative vigor for their age, or from trees losing vigor because of advanced age, can possibly lead to the carrying-over of inherent defects. On the contrary, it must be remembered that in the virgin forest the bulk of natural reproduction must come from veterans which have finally reached the "top of the ladder" and are in their declining stage so far as vegetative vigor is concerned.

5. From the standpoint of the seed-collector or purchaser, those trees and those cones are to be avoided which are large, succulent, greenish, and tend to dry early on the tree or when sacked. The more desirable cones of Norway pine are relatively small, purple in color and solid in the sense that they contain more moisture and do not open so quickly when removed from the tree. Somewhat the same characteristics, it is believed, appear in other pines. Purchasing cones on the basis of weight tends to put a deserved premium on the smaller and heavier cones, although perhaps not even as much as desirable, while purchasing by the bushel gives much lower values when the light, green type of cones are obtained.

6. Seeds from the desirable cones often have a distinct "resting period" and must not be expected to show high germination until they have been stored for some time. This is not a universal characteristic, however. In conformity with practices which have been effective in other similar cases, it is believed that their germinability when wanted the following spring is best to be guaranteed by completing the extraction of the seeds and putting away in cold storage, near or even below the freezing temperature, this also being desirable procedure for retaining the vitality of seeds which are ready to germinate.

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THE EFFECT OF HIGH TEMPERATURES ON SEED GERMINATION

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The seeds of certain species of shrubs in the Sierra Nevada Mountains resist higher temperatures than the seeds of the associated coniferous species, and the germination per cent of some is actually raised by heating. This may account for the failure of the conifers to recapture a burned-over area and their replacement by shrubs to develop "brush fields."

An outstanding feature of the California Sierra Nevada forests is the frequent occurrence of areas of brush within stands of timber. Typically these brush types are best developed on lands that have been repeatedly burned over. A possible factor of significance in this regression to brush appears to be the effect of fire on seed viability.

It is reasonable to assume that seed able to withstand heat with least injury would have an advantage over other seed present in the soil at the time of a fire.

In the investigation here reported[1] the objective was to determine the influence of high temperatures on the germination of seed from native species, and particularly the temperatures lethal to seed of shrubby plants as compared to seed of trees and grasses of the same plant association.

Review of Literature

The effect of high temperatures on the viability of seeds has received the attention of investigators for many years. The investigations dealing with dry, constant temperatures are pertinent to this study and a brief review of some of the results obtained is desirable.

Breasola (2) heated mixed lots of leguminous and Cuscuta seed at 75 degrees C. for one hour. He found that the germination of planted *Cuscuta trifolii* seed decreased from 43.6 to 11.8 per cent and *C. arvensis* from 55.6 to 0.2 per cent. The viability of the leguminous seed was not affected by the heat treatment.

Templeton (20) heated cotton seed for two minutes to a maximum of 57 degrees C. in an attempt to kill the pink boll-worm. He states that this treatment had no apparent effect on the viability of the seed.

Atanasoff and Johnson (1), Burgess (3) and Kienholz (13) have demonstrated variations in the heat enduring qualities of other agricultural seeds.

Korstian (14) in studying the effect of high temperatures on acorns found that those of white oak were the most susceptible. Exposures of fifteen minutes at 300 degrees F. destroyed the

[1]For helpful suggestions and advice received during the study of this problem and for friendly criticisms of this paper, an expression of thanks is due Dr. A. W. Sampson and Prof. F. S. Baker, of the University of California, and Dr. E. P. Meinecke and Willis W. Wagener, of the Office of Forest Pathology, U. S. D. A.

germinative power in all the species studied.

Hofmann (11) reports that no germination was secured from western white pine and Douglas fir seed after exposure to 200 degrees F. for ten hours.

The literature contains a great mass of information of a similar nature, mostly concerning seed of important agricultural plants. This brief review is fairly representative and additional references are not essential.

Methods and Procedure

The majority of the species included in the present study are native to California and occur mostly in the Upper Sonoran and Transition life zones. The seed of two important tree species of these zones, namely *Libocedrus decurrens* and *Abies concolor*, was not available in sufficient quantity to be used in the tests. Germination tests of seed from the following coniferous species are reported upon in this paper: *Abies magnifica, Pinus contorta, P. lambertiana, P. ponderosa,* and *Pseudotsuga taxifolia.* Shrubby plant species included are *Adenostoma fasciculatum, Ceanothus crassifolius, C. divaricatus, C. macrocarpus, Rhamnus californica, Rhus laurina* and *R. ovata.* The grass species are *Avena fatua, Bromus hordeaceus,* and *B. rigidus.*

All seed was prepared in the same manner. It was air dried and freed of capsules, glumes and other integuments before being subjected to the tests. Seed was stored in tin containers at room temperatures.

The seed was heated in lots of 50 of each species but 100 unheated seeds constituted the check lots. Only dry heat was used. For rapid heating a "Despatch" electric oven was employed. Longer exposures and more constant temperatures were obtained in a "Freas" automatic oven.

The first step was to ascertain the relative temperature endurance of seed of the species studied. This was determined by exposing each of a number of lots of seed for five minutes to a certain temperature, e.g., one lot was exposed to a temperature ranging between 100 and 120 degrees F., another to one ranging between 120 and 140 degrees F., and so on up to 300 degrees F. at intervals of 20 degrees. For each lot the temperature was held within a 20-degree range. The oven was pre-heated but when the seed was introduced the temperature dropped and it required approximately 20 seconds to secure the desired temperature. In order to reduce temperature fluctuations to a minimum, the seed was heated in groups of about a dozen lots.

To determine the effect on seed of prolonged exposures, tests were also run for longer intervals (15 minutes to 4 hours) at the constant temperatures of 104 degrees and 212 degrees F.

To determine germination, untreated and treated seed was placed between moist blotters in an electric germination oven maintained at a constant temperature of 68 degrees F. Other lots were planted in sand beds located in a greenhouse. Tap water was used to keep the medium adequately moist and was applied daily and as evenly as possible. Germination counts were made at weekly intervals.

When no germination took place in

seed exposed to the higher temperatures, the experiment was repeated. If the same result was obtained the assumption seemed justified that the extreme heat had killed the seed.

In studying the effect of high temperatures on seed germination, it was important to determine how much time was required for the interiors of seeds to attain a temperature comparable to that of the oven. To investigate this part of the problem thermocouples 0.006 inch in diameter were inserted through minute holes made in the seed coats to fit the wires. The holes extended approximately to the center of the seed of *Pinus ponderosa*, *Abies magnifica* and *Rhus ovata*. It was found that it required nearly four minutes for the interior of the seed to reach the oven temperatures of 150 and 250 degrees F. The temperatures rose at approximately the same rate in the three species named regardless of seed coat thickness.

When the ends of the thermocouples were placed in the oven they registered instant response to heat. This indicated that the thermocouples inserted in the seed gave fairly dependable readings.

Results and Discussion

In the initial tests the seed of twelve species gave less than two per cent germination and are therefore eliminated from consideration. This may be accounted for by the fact that several of the species had been taken from old collections, and seed of *Arctostaphylos* (Manzanita) and *Ceanothus* spp. proved to be so badly infested with weevils that it was necessary to discard them. The rest of the seed was gathered the season preceding the tests or was purchased through commercial channels.

Unfortunately the exact history of the seed is not known in each case, because the source and vigor of the parent plant greatly influences the size and quality of the seed as has been demonstrated by Willis and Hofmann (21) Busse (4) and others.

Due to the difficulty in collecting some of the seed and to the time-consuming work of cleaning, sorting and counting, it was impractical to include more than 50 seed in each test and 100 seed for checks.

Table 1 summarizes the results in percentage of germination after the seed had been exposed for 5 minutes to various temperatures as previously noted. The results however cannot be considered conclusive because of the small number of seed used in each lot.

In Table I it is shown that the seed of certain shrubby plants endured higher temperatures than any of the other species studied. The seed of *Rhus laurina* and *R. ovata* endured the highest temperatures of all and showed remarkable gains in germination per cent over unheated lots. With few exceptions the germination percentage of shrubby plant seed was raised by the action of heat. The seed of shrub species which withstood the most extreme temperatures may be subject to delayed germination or prolonged dormancy. Seed in this latent state have been found to be very resistant to high temperatures (9) but high temperatures may also break the rest period and stimulate germination (19).

TABLE 1.

GERMINATION OF SEED AFTER FIVE-MINUTE EXPOSURE TO HEAT
DURATION OF GERMINATION EXPERIMENT 112 DAYS

Temperature in degrees Fahr.	100 to 120	120 to 140	140 to 160	160 to 180	180 to 200	200 to 220	220 to 240	240 to 260	260 to 280	280 to 300	Checks
Conifers					*Germination in per cent.*						
Abies magnifica Murray	34	26	32	22	6	4	0	0	0	0	4
Pinus contorta Loudon	62	54	54	44	42	48	48	0	0	0	64
Pinus lambertiana Dougl.	0	2	0	0	2	0	0	0	0	0	2
Pinus ponderosa Lawson	48	66	64	66	76	62	48	0	0	0	64
Pseudotsuga taxifolia (Poir.) Britt.	46	62	54	48	40	24	4	0	0	0	46
Shrubs											
Adenostoma fasciculatum H. & A.	4	6	12	8	8	16	8	0	0	0	15
Ceanothus crassifolius Torr.	8	4	16	12	8	2	0	0	0	0	16
Ceanothus divaricatus Nutt.	12	14	14	24	40	34	34	68	28	0	12
Ceanothus macrocarpus Nutt.	6	12	8	6	14	8	24	10	0	0	15
Rhamnus californica Esch.	46	60	64	70	48	26	2	0	0	0	59
Rhus laurina Nutt.	8	12	20	34	44	52	52	28	6	2	13
Rhus ovata Wats.	2	2	10	4	32	22	28	26	2	2	6
Grasses (Germination completed in 28 days)											
Avena fatua L.	52	50	54	68	74	82	60	0	0	0	60
Bromus hordeaceus L.	98	96	90	92	100	82	78	34	0	0	91
Bromus rigidus Roth.	100	100	100	100	100	2	0	0	0	0	100

Among the grass seed that of *Bromus hordeaceus* endured the highest temperature and ranks next to the more resistant shrub seeds in this respect. This species is frequently found on burned-over land. No prolonged state of dormancy exists in the grass seed used and the ability to endure high temperatures appears to be due to other factors.

Of the coniferous species the seed of *Pinus ponderosa* and *P. contorta* endured moderately high temperatures. Temperatures below 180 degrees F. decidedly raised the percentage of germination of *Abies magnifica* seed as compared to the check. It is interesting that high temperatures failed to break the rest period characteristic of *Pinus lambertiana* seed.

Delayed germination, of many probable factors, may be of importance in the resistance of certain seed to high temperatures. One other influencing factor could be the degree of desiccation. The literature does not agree upon this point.

Crocker and Harrington (6) showed that the seed of wheat, barley and certain grasses when dried to less than one per cent moisture content gave satisfactory germination. Schroeder (18) working with barley and wheat and Nobbe (17) with rye seed had reached similar conclusions. Waggoner (21) reduced the moisture content of radish seed to 0.4 per cent and found no effect on germination. On the other hand Ewert (8) has concluded that even with the most resistant seed with which he worked, it is impossible to reduce the percentage of water content to lower than 2 or 3 per cent of the dry weight without injuriously affecting vitality.

To determine the effect of desiccation and long exposures to high temperature, a series of tests was made. This was divided into two parts by exposing one part to the constant temperature of 104 degrees F. and the other to 212 degrees F. The time of exposure for separate lots was 5, 15 and 30 minutes, one and four hours. Two lots of 50 seed each constituted a test. One lot was planted in a greenhouse bed of sand and the other placed in a germination percentages based on an averag of the two lots are given in Table 2. Checks consisted of two lots of 100 seed each which were placed under the same germinative conditions as the heated seed. The average per cent of germination is also given for the unheated lots.

This series of tests was run approximately one year later than the initial tests and seed from the same lots was used.

It was interesting to find that the one year older seed of *Pinus ponderosa* and *Pseudotsuga taxifolia* was more sensitive to an exposure of 5 minutes to 212 degrees F. than to 200 to 220 degrees F. as given in Table 1. This conclusion may however be considered weak because of the limited data. *Pinus ponderosa* seed gave 38 per cent less germination than the year before. Seed of *Pseudotsuga taxifolia* suffered a loss of 22 per cent but the checks also showed a loss of 13 per cent in the older lots. The seed of the other species gave remarkably little variation in percentage of germination between the newer and older lots, both in checks and heated seed.

The moisture content percentages in

TABLE 2.

EFFECT OF DURATION OF TEMPERATURE ON DESICCATION AND GERMINATION
(Duration of test 56 days)

(a) Exposure to 104 Degrees F.

Species	Pinus ponderosa		Pseudotsuga taxifolia		Rhus laurina		Bromus hordeaceus	
Exposure	Moisture content, per cent	Germination, per cent	Moisture content, per-cent	Germination, per cent	Moisture content, per cent	Germination, per cent	Moisture content, per cent	Germination, per cent
None (Check)	7.3	71	7.8	33	15.4	17	17.0	92
5 minutes	6.9	54	6.8	10	14.9	8	16.1	92
15 minutes	6.4	75	5.4	34	14.5	14	15.3	93
30 minutes	6.0	81	5.0	25	14.1	10	14.8	92
1 hour	5.3	63	4.1	31	13.7	12	13.2	88
4 hours	3.8	75	3.2	14	13.2	14	12.6	87

(b) Exposure to 212 Degrees F.

Species	Pinus ponderosa		Pseudotsuga taxifolia		Rhus laurina		Bromus hordeaceus	
Exposure	Moisture content, per cent	Germination, per cent	Moisture content, per-cent	Germination, per cent	Moisture content, per cent	Germination, per cent	Moisture content, per cent	Germination, per cent
None (Check)	7.3	71	7.8	33	15.4	17	17.0	92
5 minutes	4.4	24	3.0	2	11.1	54	8.7	88
15 minutes	2.2	3	0.6	2	9.4	56	6.4	84
30 minutes	0.8	0	under 0.6	0	8.1	30	5.9	92
1 hour	under 0.8	0	under 0.6	0	6.4	29	5.0	89
4 hours	under 0.8	0	under 0.6	0	4.6	30	4.2	79

Table 2 were calculated on the basis of dry weight of 50 seed taken from each species after each period of exposure.

It appears that the percentage of moisture remaining in the seed after exposure to heat is not the important factor that influences heat endurance in the species here tested. For example, *Pinus ponderosa* seed after exposure for 4 hours to 104 degrees F. gave 75 per cent germination when the moisture content was reduced to as low as 3.82 per cent. For seed of the same species exposed to 212 degrees F. for 5 minutes, the germination was reduced to 24 per cent even when the remaining moisture was at a higher percentage. On the other hand, *Rhus laurina* seed exposed to 104 degrees for 4 hours gave only 14 per cent germination with the relatively high moisture content of 13.17 per cent. Germination was, however, raised to 54 per cent in seed exposed to 212 degrees for 5 minutes with the moisture content decreased to 11.13 per cent.

These tests indicated that the varying endurance among seeds to high temperatures cannot be satisfactorily explained by the degree of desiccation.

It has been suggested in the literature that the seed coat may have some influence on the resistance of certain seeds to heat. Recently Korstian (14) showed that the resistance of acorns to high temperatures decreased with decreasing seed coat thickness.

In Table 3 the thickness of the seed coats of five representative species used in this study are given. Lethal temperatures obtained on the basis of 5 minute exposures indicate the temperature endurance of the seed.

TABLE 3.

THICKNESS OF SEED COATS IN RELATION TO LETHAL TEMPERATURES

	Average thickness of seed coats	Lethal temperatures
hus ovata	0.45 mm.	320-330°F.
eanothus divaricatus	0.25 mm.	280-290°F.
nus ponderosa	0.25 mm.	240-250°F.
eudotsuga taxifolia	0.13 mm.	240-250°F.
omus hordeaceus	0.08 mm.	260-270°F.

The degree of heat endurance in the ve species selected is shown to follow irly closely the seed coat thickness. was also found that seed which enured the most extreme temperatures equently had very hard seed coats of mplicated cellular structure.

Another factor to be taken into conderation in studying the protection hich seed coats may offer against high mperatures is that in many species of ymnosperms, particularly the pines, e seed coat consists of two halves with more or less pronounced seam along hich it quite readily separates. None the Angiosperm seeds included in is study had this characteristic. High mperatures and long exposures may sult in the separation of the two lves of the coat. This not only subcts the embryo of the seed more dictly to high temperatures and rapid ss of moisture but also to very rapid sorption of water when placed under rminative conditions. While in acely growing plants rapid changes equently have an injurious effect, ed in the dormant state can withstand pid drying and sudden moistening). The Gymnosperms used in this idy, with the exception of *Pinus lamrtiana,* were apparently not in a state complete dormancy and it is possie that rapid absorption was injurious. At the beginning of this paper it was stated that in the three species selected the temperatures rose in approximately the same length of time regardless of seed coat thickness. Heat may have an indirect influence, however, on the permeability of hard seed coats. This may explain why germination was accelerated in several of the shrubby plant seeds. This explanation would be in accord with the conclusions reached by Crocker (5) that delayed germination is more often due to characteristics of the seed coat than to those of the embryo. *In Pinus lambertiana* the state of dormancy may possibly be prolonged on account of the immaturity of the embryo.

No one factor, however, is likely to be responsible for the variation of seeds in enduring high temperatures. There are many factors to consider. Among the most important is the chemical composition (9), the effect of heat upon colloidal material in the cells (15), and on enzymatic activity (7) (16), the effect of light on germination (9), the color of the seed coat (9) (10), all of which were not specifically investigated in this study.

SUMMARY

Most of the seed experimented with came from species typical of the Upper Sonoran and Transition zones in the

Sierra Nevada Mountains of California.

The experiment indicates that seed of certain shrubby plants endured higher temperatures than coniferous or grass seed, the species of which occur in the same association. This may partially account for the aggressive invasion of shrubby plants on burns and the formation of typical brush fields as a result of forest fires.

The ability of seed to endure high temperatures cannot be satisfactorily explained on the basis of varying degrees of desiccation. Endurance to high temperatures may possibly be related to seed coat thickness. Heat may increase seed coat permeability and so aid in breaking dormancy.

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A sound forestry policy must be based on facts and not on assumptions. It is early as logical to assume that any land not fit for forests ought to be in agriculture as to say that land not fit for agriculture ought to be in forests. The basis of utting more land into any use ought to be the social needs or advantages from at use. There may be no danger in the near future of putting too much land into prestry, but it is quite conceivable that forestry could be over-expanded just as griculture has been. The assumption that "idle acres are a burden, and ought to e in forests" is not a sound basis for a forest policy. No one knows what constitutes idle acres. Virgin forests may produce practically nothing, for growth just bout equals decay. Are they idle acres kept in reserve? May it not be wise to eep some idle agricultural land in reserve also? The whole question of land tilization ought to be: Will this or that use pay when everything is considered? here can be no greater burden than using land for something that does not pay, fact which many sub-marginal farmers know from experience. In the case of fortry the effect on climate, stream-flow, wild life, and human beings must be condered along with the money value of the direct products.

Excerpt from "*What About the Year 2000?*"

FOREST TREE DISEASES AND THEIR CONTROL[1]

By E. P. MEINECKE

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Forest tree diseases regard no political boundaries. Safeguarding forests against them gives the field of forest pathology a world aspect. In this masterly paper, by a man who is regarded as a leader in developing the practical application of the science of plant pathology, are discussed the scientific, technical, and economic aspects of controlling the continuous attrition of forest growth by diseases. This contribution is particularly interesting and suggestive to silviculturists and forest managers.

FOREST PATHOLOGY embraces the study of those factors which cause damage or loss to the forest as an ecologic and economic unit. Its ultimate goal is the control of these influences and their reduction to the lowest level possible within the limits of practical forestry. As a discipline it originated in Europe as a necessary adjunct to the mighty development of forestry during the last hundred years. The birth of the nineteenth century marks the birth of modern forestry. Europe, threatened with a timber shortage, began to convert its half-wild forests into cultivated units on the basis of scientific research, an undertaking of stupendous proportions. The enormous expense of time, labor, and money entailed tended to invest the individual trees composing the stand with special importance. Perhaps the most significant characteristic of the new order consisted in the most advantageous arrangement in space of the species best adapted to a given site. Unless, under this system, every individual produced the maximum of wood the economic success of the new forest was in jeopardy. With the second half of the century the revolutionary change in European forestry began to bear its first fruits, and at about the same time the attention of foresters was forcibly directed to the losses incurred by tree diseases which made heavy inroads into the calculated production. This period marks the beginnings of forest pathological research. Since this time the control of injurious factors in the cultivated European forests has been closely tied up with the practice of forestry itself. The short rotations and the constantly and periodically recurring improvement cuttings which are a part of intensive forestry normally tend to reduce the major sources of injury, and the close utilization that makes improvement cuttings economically possible permits a system of supervision and inspection extending to the individual members of the forest community. But even under such favorable conditions and with the small number of tree species involved the well-managed European forests have not been free from serious outbreaks of tree diseases.

[1]Presented to the Inter-American Conference on Agriculture, Forestry and Animal Industry at Washington, D. C., September 8-20, 1930.

In the two Americas constructive for-
stry is still in its beginnings. An mmense area of virgin forests of the nost diversified and complex nature, omposed of a host of different species, eaching from the Tropics far to the outh and north and subject to widely arying economic conditions still awaits he directive mind that will bring order ut of chaos.

The virgin forest is prodigal in the roduction of trees and shrubs but not n the production of timber. The eco-omic values it contains are stored in elatively few individuals, in number nd in volume far below the potential apacity of the soil. Against the growth f the trees stands the slow and con-inuous attrition by diseases and insects, y windstorms, lighting, hail, drought, nd frost. The conversion of this under-roducing forest into one of high pro-uctivity is the object of constructive orestry. The elimination or reduction f the factors that lower the produc-vity of the forest is the object of forest athology.

The realization, slow to awaken but aining speed from year to year, that a oming timber shortage can be averted nly through energetic and systematic ction is beginning to spread over the hole continent though so far only ome of the governments and semi-ublic institutions have been able to y the foundations for a system of for-stry adapted to American conditions. he first and at the same time the most ifficult step in the creation of construc-ve American forestry is the slow con-ersion of the raw material represented y the wild virgin forests into a pre-minary form of transition forest which then will form the basis for the managed forest of the future. Formidable obstacles of an economic and technical nature stand in the way, but not until forestry has emancipated itself from the ruthless exploitation of the great values inherited but not created by man and turns to the deliberate and organized growing of producing forests can the wood supply of the New World be assured.

It is due to the rapid conquest of North America by the European races that its supply of timber today is seriously on the wane. The settler needed arable land, unobstructed by trees. He needed wood and the virgin forest offered a wealth of high-grade timber. Under his ax the forest fell. The growing cities and industries fostered the development of a huge lumber industry which exploited the forest without regard to the future. Devastating forest fires took heavy toll, and chaparral and worthless species occupied the place of the old forest. Today there remains in the United States only a fraction of the former virgin forests in the less densely populated Western part of the country. In the Northeastern States, where the destruction of the virgin forest began and where it has long ago reached its culmination, young forests are beginning to spring up, and the still remaining old forests of the South, the Southwest, the Rocky Mountains, the Pacific Coast and the Northwest are interspersed with ever-increasing areas of reproduction where the ax has opened up the age-old stands. In the uncut timber the same process of attrition through natural causes is going on unchecked and the young growth, on which future

generations must rely for their needs, will necessarily revert to the virgin type unless it is protected against the elements that endanger its existence or interfere with its normal and vigorous development. There derives from this a twofold direction of objectives in forest protection, namely the rational treatment of the remaining virgin stands and the control of diseases of young timber.

Wood as an economic commodity is stored in the main stem of trees large enough to be utilized. Here lies the forest capital accumulated during centuries. By far the greater part of the wood no longer participates in the physiological life processes of the tree. It turns into heartwood, which on account of its relative durability and other desirable properties is more highly prized, for many forms of service, than the sapwood with its low resistance to decay. In the living forest tree, however, this relation is reversed. There are but few species of forest trees in which the loss from decay of the heartwood does not eat heavily into the timber capital.

Decay in the standing tree is caused by a large group of fungi, belonging to the Polyporales. The vegetative body of the fungus, boring with extremely fine hyphal threads through the cell walls of the wood extracts from these certain components for its food and leaves a residue of others which it can not utilize. It is this remnant of broken down cell walls which is commonly called decay or rot. From small beginnings the fungus expands in the body of the tree until it occupies practically the entrie cylinder of heartwood and renders it worthless for use. When the fungus has reached maturity it produces, on the outside of the bole, a characteristic form of fruiting body or sporophore giving off minute spores in enormous quantities which carry the disease to other trees. Germination takes place whenever conditions of temperature and moisture are favorable. Since most of these fungi are strictly confined to the heartwood the germinating spores can establish themselves only when they happen to land on unprotected heartwood, for instance on wounds caused by fire, by the glancing blow of falling trees or heavy limbs and by frost cracks, or on the exposed heartwood of branch stubs or broken tops. Of these different possibilities of entrance the wounds caused by fire and the branch stubs are by far the most common. Some of the most injurious fungi, for example the very common *Trametes pini*, widely spread in pines and in Douglas fir (*Pseudotsuga taxifolia*), enter in the main through branch stubs. Others, like *Echinodontium tinctorium*, which causes heavy losses in the true firs and in Tsuga, generally choose wounds caused by forest fires. The mode of entrance has a distinct bearing on the distribution of the ensuing decay within the tree. Since fire scars are mostly confined to the base of the tree the decay starting from these causes primarily the destruction of the lower part of the bole which yields a greater proportion of high-grade clear lumber than the tapering and limby upper part. It is obvious that the first and paramount condition for the protection of the forest from the ravages of heartwood-destroying fungi lies in the prevention of forest fires.

The loss from decay in the virgin

orest varies greatly with site and tree pecies represented. In practically every ıstance it affects the exploitation and ıe profitabilility of logging operations. n some cases the net volume of wood, fter deduction is made of the volume estroyed by rot, is so insignificant that : does not even compensate for the in- estment in equipment and labor neces- ary to harvest it. While the cull per ent—that is, the percentage to be de- ucted for decay in the standing virgin rests—is not known for all species nd all regions of the United States, ıere are figures available based partly n accurate investigations, partly on ood evidence which tend to show that ıe estimated gross volume of the virgin rests of the country must be dis- ounted by about 15 per cent. The cull er cent for hardwoods over the coun- y is about 19 per cent, and that for oniferous species about 14 per cent. he great timber reserves of the western art of the United States are altogether mposed of coniferous species. Here e cull per cent is figured as 15.5 per nt, varying according to species from per cent in *Pinus ponderosa* to 30 r cent in *Sequoia sempervirens*, the luable gigantic redwood of the Cali- rnian Pacific coast.

While these figures are helpful in a neral appraisal of the actual net wood pital of the country they can not be plied directly to individual regions localities. The same species may ffer heavily in certain localities and far less subject to loss in others. In ct, there seems to exist, at least for rtain species, a definite relation be- een vigor of growth of the host and e virulence of attack by the parasitic fungus. Such a relation comes out clearly when the rate at which the decay progresses in the trees is made the subject of study. The very young tree does not possess heartwood, hence it does not offer a congenial substratum to the type of fungi here under discussion. But with the beginning of heartwood formation the first infections begin to appear. At first the resulting loss is negligible, but soon the fungus extends over an appreciable volume of heartwood. As long as the tree grows vigorously the fungus lags behind in growth but with the slowing up of increment in the old tree the parasite in its interior gains upon it until the increment of the fungus by far exceeds that of the tree and the volume inhabited and decayed by the fungus occupies practically the entire heartwood. A similar relation seems to obtain, at least in certain cases, in different parts of the range of a given species. Exact studies on decay in white fir (*Abies concolor*) in California have shown that the ratio of decayed volume to sound volume in corresponding age classes is far lower in the optimum of the range of white fir than it is nearer the limit of the range. Within the optimum the trees continue vigorous growth into old age and the decay still leaves a net volume of sound wood even in the highest age classes while in the less favored regions the slow growth of the trees is soon overtaken by the growth of the fungus within them.

In the American virgin forests there can be no direct method of control of wood destroying fungi. The individual tree, infected though it may be, does not possess sufficient value by itself to warrant its elimination from the forest,

in order to salvage what sound wood it may contain and to remove a source of infection to other trees. Control can be applied only *en masse,* that is at the time that the timber of a whole unit is harvested in the first step toward conversion. Here the principle applies that thorough utilization of the cut timber must be combined with effectual sanitation of the stand so that the young forest will grow up under the most favorable conditions. The Forest Service of the United States which does not carry on its own logging operations but sells stumpage to the highest bidder, has inserted certain standard clauses in its sale contracts which guarantee both the salvage of sound wood in infected trees and the elimination of diseased individuals for the protection of the young stand.

The realization that decay represents a growth within growth and that decay increases rapidly with the age of the trees affected has its bearing on the formulation of the silvicultural program. Only in very few cases will the old forest be cut down for the sole purpose of making room for young growth. It is the harvesting and utilization of the mature and overmature timber that ushers in the new forest, and in the choice of the timber to be cut it is evident that the rate at which decay is progressing presents an important factor in the equation. Other things being equal the timber in which decay rapidly destroys wood values and in which replacement through increment is sluggish should be cut in preference to sounder and more vigorously growing stands. This choice is a matter of judgment based upon the weight to be given to the character of the stand, to the relative value of its component species from the economic and the silvicultural point of view and to the type of wood-destroying fungi present.

The heartwood-destroying fungi are not the only sources of loss of a pathological character. Strictly speaking they are not parasitic since the heartwood they inhabit is dead and since they merely consume the accumulation of centuries of annual growth. They do not interfere directly with the life functions which make this annual increment possible. The diseases, on the other hand, that are caused by active parasites drawing all or most of their substance from the living tissues of forest trees are a most important source of loss in the sense that they either kill the infected individuals outright or, in varying degrees, reduce or inhibit the increment, the essential factor in the production of wood.

In the old forest in which the increment of decay is on the increase while the rate of volume increment is slowing up any additional factor tending further to depress normal growth is likely to mark the dividing line between success and failure in the productiveness of a given stand. One of the most striking examples of a biotic factor of this nature in the United States is represented by the mistletoes of the genus *Razoumofskya* which are widely spread on a number of coniferous species of the Western United States. Like many of the tropical members of the *Loranthaceae* they are truly parasitic and in general are strictly confined to individual or closely related hosts. Capable of living with their host to an old age they cause

ar-reaching local disturbances, resulting in distortions and the formation of normous witches'-brooms. Seed production of the parasite is prolific, and s a consequence a single tree may carry undreds of infections. The cumulative ffect of this multiple drain on water nd foodstuffs expresses itself in a ronounced depression of the increment. While old trees as a rule are not killed y the mistletoes there is a fairly heavy nortality among young individuals. If he latter survive the chances for their rowing up into normally producing dults are highly unfavorable. Unortunately some of the most valuable imber species suffer very severely from nistletoe. Without exaggeration it can e said that the control of the parasite, or instance, on Western yellow pine *Pinus ponderosa*) must be considered ne of the most baffling problems in North American forest pathology. Diect control by eradication in the standng forest is out of the question on ccount of the magnitude of the task. The only indirect method feasible under resent conditions is that adopted by he Forest Service of the United States n its timber sales. In the marking of he trees to be felled special weight given to those exhibiting heavy inections. By this means the greater umber of individuals are eliminated hich are likely to act as sources of nfection to young reproduction, even hough a complete eradication can not e effected.

While the mistletoes indiscriminately nhabit trees of all ages the great ajority of the fungi of a truly parasitic haracter can be said to be more inurious to young growth. In general, the older trees are able to withstand their attacks unless the latter appear in overwhelming numbers and are cumulative in effect. Practically all parts of forest trees, roots, stem, branches and foliage, are beset by an endless variety of parasitic fungi. They all have this in common, that they live at the expense of the host, but the extent of injury depends on the virulence of the fungus and on the number of infections present. In certain cases single infections by destructive fungi cause quick drying. In others the combined effect of thousands of minor infections produces serious disturbances. On pines and other coniferous trees a severe attack by needle-inhabiting fungi frequently is equivalent to complete defoliation. Figured over a whole stand the loss in increment is, in the aggregate, a very heavy one. Under the present conditions of extensive management there is no way open to deal with this type of diseases in the old forest. With the approach to more intensive forestry and to closer utilization much can be achieved in the reduction of the more serious of these diseases in young growth through silvicultural means, in particular through regulation of the density of the stand.

Detrimental as the reduction of increment must be in the forest the main objective of which is the production of wood it affects the ultimate return far less than does killing on a large scale through the agency of parasitic fungi. The sum total of potentially producing trees lost annually throughout the forests on account of killing diseases is undoubtedly very great, but fortunately it is rare, in contradistinction to the

behavior of many forest insects, that an indigenous fungous parasite will multiply suddenly and flare up into a serious menace though such cases have been known to occur. The greatest menace from killing epidemics has come through the accidental introduction of foreign diseases.

It is a common experience that certain diseases, harmless enough in their own habitat, may assume formidable proportions when they are transferred to new surroundings where they find more congenial conditions and more susceptible hosts. The development of modern transportation and the free interchange of commodities throughout the world have made the accidental distribution of pests inevitable. One of the most serious of all forest diseases, the white pine blister rust (*Cronartium ribicola*), has in this way expanded its range from Western Siberia to Central Europe where it encountered the extensive plantations of white pine (*Pinus strobus*), a highly valued species of the Eastern United States. Innocuous on *Pinus cembra*, its Siberian host, it found in white pine a host of low resistance and soon rendered the further cultivation of this species unprofitable. From Europe the disease was introduced on planting stock to the United States into the very home of white pine. In view of the great economic importance of this pine in the eastern states the invasion by this unusually destructive fungus could only be regarded as a calamity of no mean proportions. To complete the measure the disease later made its appearance in the Far West on a close relative of white pine in an important region of virgin timber where the entire lumber industry was based on the exploitation of the threatened pine. In this emergency the indirect method of control gave little promise of success. The life history of the fungus, however, offered a mode of direct attack. The rust is heteroecious. One generation lives exclusively on the pine and the spores produced can not again infect pines. They transfer the disease under a different form to certain currants and gooseberries. After this generation has run its course it returns again to the pine. It follows that the removal of one of these two links must break the chain of generations, and since the pines are the object to be protected it suffices to eradicate the economically unimportant currants and gooseberries to bring about the desired result. This method of eradication has been practiced on a large scale, and though costly has proved to be highly effective, in proportion to the thoroughness of the eradication. But it must not be forgotten that, except locally, there can be no question of a complete eradication and that forestry based on white pine and its relatives is forever saddled with the heavy cost of control.

Another disease, also imported accidentally, has brought to this country the greatest catastrophe in the world's history. The chestnut bark disease or chestnut blight, a canker disease caused by *Endothia parasitica*, was brought to the Eastern United States on nursery stock from Japan where it is widely spread on native chestnuts without doing much damage. On this continent it found a congenial host in the American wild chestnut, *Castanea dentata*, one of the most important hardwood trees of

the eastern United States, valued for its wood of high quality, for its nuts, and for the tanning extracts of its wood. Infection takes place directly from tree to tree so that the only method of control would have consisted in the systematic eradication and destruction of all infected trees, a method applicable only in the very beginning of the epidemic. At that time no central agency charged with forest pathological work existed in the country, and soon the disease swept unchecked over the immense range of chestnut, leaving destruction in its wake. Today only small remnants of the once flourishing American chestnut are left and as an economic asset chestnut has ceased to exist.

The recent discovery, in the northeastern United States, of the European larch canker, one of the most dreaded of European forest diseases, has brought forth energetic measures of control through systematic eradication of all infected trees. This disease also is an imported one. It was introduced on nursery stock from Scotland. What its future in this country is going to be no one can tell. The menace it brings to the extensive American larch forests emphasizes the lesson learned by bitter experience from the history of the white pine blister rust and the chestnut bark disease.

To find its true place in modern forestry the science of forest pathology must be organized on international lines. No longer can it be satisfied with the study of the cause of the progression of native forest diseases but it must reach out across political boundary lines in a spirit of mutual support and helpfulness. The nations of the two Americas have a common interest in building up their forests for the benefit of coming generations and to this goal the protection of the forests against diseases is one of the most promising and essential conditions.

THEORY IN EXPLANATION OF THE SELECTION OF CERTAIN TREES BY THE WESTERN PINE BEETLE

By HUBERT L. PERSON

U. S. Bureau of Entomology[1]

Knowledge of why the western pine beetle attacks certain trees may make it possible to reduce insect losses on selectively-logged areas by leaving only those trees least attractive to the beetle and having therefore a better chance to survive until the next cut. Studies here reported indicate that an initial weak attraction is due to the formation of volatile oils, such as aldehydes or esters, which are by-products of a respiratory fermentation or abnormal enzyme activity in subnormal trees. This attracts beetles from the immediate vicinity, these in turn introduce a yeast into the inner bark which produces a fermentation strong enough to attract other beetles from a wider radius.

As a result of preliminary studies on tree selection[2] and more recent sample-plot studies, it is known that certain western yellow pine trees (*Pinus ponderosa* Lawson), as characterized by rate of growth, tree class, crown class and diameter class, are more likely to be killed by the western pine beetle (*Dendroctonus brevicomis* Lec.) than the other trees in the stand. The higher rate of mortality in certain tree classes must be due either to a lack of resistance or to the fact that the beetles are able to make a definite selection of certain trees. If it is the result of differences in resistance we could assume that the probability of attack is equal for all trees in the stand, and that only the trees which have little resistance succumb. In that case we should expect to find many trees which had been unsuccessfully attacked. Such trees would be easily found, as the pitch tubes formed on trees which resist attack are easily seen. As a matter of fact, in all the insect cruises with which the writer has been connected within the last eight years, a tree that has successfully resisted a noticeable attack by the western pine beetle is almost a rarity. This fact, as well as all the other observations which have been made on this beetle, show that the killing of only certain trees is not a question of resistance or lack of resistance, but is the result of a more or less definite selection by the beetles.

Although it is true that in a majority of cases the slower-growing trees which are found in Dunning's tree classes IV and V, and which have the smaller crowns and are of medium diameter, are apparently more attractive than the other trees in the stand, neverthless

[1]This paper summarizes the results of attraction studies which have been carried on in California under the direction of Dr. F. C. Craighead and J. M. Miller, of the Division of Forest Insects, Bureau of Entomology. The writer wishes to acknowledge the assistance of N. T. Mirov, who carried out the oleoresin experiments and helped with the attraction tests, and of R. N. Jeffrey, who had charge of the studies on the chemistry of the inner bark. A more technical treatment of this part of the work will appear in an article by Jeffrey.

[2]Tree Selection by the Western Pine Beetle, by H. L. Person, Jour. Forestry, Vol. 26, May, 1928, pp. 564-578.

here are many exceptions and apparent nconsistencies which are hard to exolain on the basis of external characeristics of the trees alone. It was decided, therefore, that a more fundanental study of the underlying causes of the attractiveness of certain trees was essential to a better understanding of he problem. During the past three years a considerable amount of work nas been done on this study; and although there is still a great deal that we do not know about it, we have been able to work out a theory for the attraction which, though not susceptible of absolute proof at the present time, at east appears reasonable.

There are four more or less distinct phases to the study, all of which contribute to the conclusions which have been reached. These phases are (1) he study of the oleoresin of western yellow pine in its relation to external characters and attractiveness; (2) the biology of some microörganisms associated with the western pine beetle; (3) he chemistry and physiology of certain sugars of the inner, living bark; and (4) experiments in which the comparaive attractiveness of a great number of substances was tested on caged beetles as a partial check on the other parts of he study.

Oleoresin Studies

The success of the first beetle attacks on a living tree depends on the ability of the beetles to overcome the flow of oleoresin resulting from the injury to he inner bark. Because of this it was hought that differences in the composiion or quantity of the oleoresin might be related to the attractiveness of a tree. We therefore obtained the services of Mr. N. T. Mirov, a forester who has had considerable experience in the distillation of oleoresin, to work out this phase of the problem. As a result of his studies, which were carried on during 1928, Mirov concluded that all of the whole oleoresins tested were repellent, but that certain fractions, particularly the less volatile oils, were less repellent or even neutral.

Attraction tests which were being conducted at the same time showed that the inner bark was the most attractive major part of the tree, therefore work on the oleoresins was discontinued, and during 1929 and 1930 most of the work was confined to the study of the inner bark.

The Importance of Micro-organisms

It was also found during 1928 that fermenting inner bark was more attractive than any of the other substances tested. This suggested the possibility that the attractiveness of attacked trees might be due to some fermentation organism, such as a yeast, associated with the beetle. To check this theory the writer carried on experiments with the western pine beetle and some of the microörganisms associated with it, under the direction of Prof. W. V. Cruess of the University of California, early in 1929.

Inoculations from a large number of new adults and larvae of the western pine beetle taken from infested bark, were made under such conditions as to prevent outside contamination, and cultures were made on a number of dif-

ferent media. As a result of these experiments it was found that spores of an undetermined yeast, probably a Torula, were always present in considerable abundance, not only on the exterior but also in the intestinal tract of both larval and adult forms. It was possible to make pure cultures of this organism, and some experiments were conducted on the fermenting capacity. Although some other yeasts, bacteria, and fungi were occasionally present in the cultures, the yeast was by far the most abundant and the only organism apparently always present on the larvae and new adults of the beetle. It was also found that inner bark inoculated with this yeast was definitely attractive to the western pine beetle.

A considerable amount of work has been done on the relation of blue stains to bark beetle attacks, particularly by Craighead[3] and Nelson and Beal[4] in the Appalachian region. Dr. R. H. Colley and the writer worked particularly on the time of establishment of the blue stain in relation to attack. Although the work with the southern pine beetle indicates that blue stain is an important factor in killing the tree, there is little probability that it has any effect on tree selection by the western pine beetle, principally because the trees are usually well attacked before there is any appreciable development of blue stain. Our culture studies also show, as already noted, that the yeast is the first organism that develops from the western pine beetle, and is much more abundant than any of the other organisms found. And finally, it is logical that a yeast would be much more likely to produce an attractive fermentation than a fungus.

Concentration of Sugars of the Inner Bark

In 1929 the study was continued, with two lines of approach. R. N. Jeffrey, a chemist and plant physiologist, undertook the determination of the concentration of certain sugars in the inner bark of a number of trees, both felled and standing. At the same time experiments were made in an attempt to compare the attractive powers of the inner bark taken from a number of trees representing extremes of growth rate. The progressive changes in the inner bark of trees after being felled and the attractiveness of fermenting inner bark were also studied, both for changes in sugars and for comparative attractiveness.

As a result of the studies of 1929 the following conclusions were reached:

1. The inner living bark is the most attractive major part of the tree;

2. Fermenting bark is the most attractive of the substances tested;

3. Jeffrey found that the concentration of the reducing sugars, particularly levulose, is higher, and that the sucrose concentration is lower, in the slower-growing, attractive trees than in the faster-growing, less attractive trees. He also found that when a tree is felled or

[3]Interrelations of Tree-Killing Bark Beetles and Blue Stains, by F. C. Craighead, Journal Forestry Vol. 26, pp. 886-887, 1928.

[4]Experiments with Blue Stain Fungi in Southern Pines, by Ralph M. Nelson and J. A. Beal, Phytopathology, Vol. 19, No. 12, Dec., 1929.

severely injured there is an increase in levulose and a decrease in sucrose, indicating a sucrose hydrolysis such as would probably be associated with fermentation. This was followed by a rapid decrease in sugars, evidently due to respiratory fermentation.

Conclusions

As a result of these studies we believe that the initial attraction of beetles to a tree is due to the formation and escape of volatile aldehydes or esters which are a by-product of a respiratory fermentation resulting from abnormal enzyme activity in subnormal trees. The causes of this subnormal condition may be drought, injuries of various kinds, or something else that interferes with the normal physiology of the tree. We get the extremes of this condition in fire-injured or trap trees, which are always selected for attack by the beetles in much greater proportion than the healthy trees of the stand.

This initial attraction, particularly in trees only slightly subnormal, is probably so weak as to be detected only by beetles in the immediate vicinity of the tree. But after a few attacks are made a second, stronger attraction is started by the yeast introduced by the attacking beetles, finding the inner bark a favorable medium for its growth. This secondary attraction is probably strong enough to attract beetles for a considerable distance, with the result that the tree is usually heavily attacked and killed.

Although this theory, as already noted, is not susceptible of absolute proof, studies now being carried on will do much toward strengthening or disproving it. These studies include the determination of the sugar relations in the inner bark of certain types of trees known to be attractive to the western pine beetle; such as, for example, trap trees, fire-injured trees, top-killed trees, and trees partially killed by other insects. The results of these studies will be reported by Jeffrey on the completion of this phase of the work.

The value of this selection theory lies in its application to forest management. In many of the yellow-pine stands of California and Oregon the loss from insects on cut-over areas is a limiting factor in profitable forestry. Any increase in our knowledge of how the western pine beetle selects the trees which it kills will make it possible to reduce this loss by leaving on our cut-over areas only such trees as will have the best chance of surviving until the next cut.

Another application is in relation to cutting sequence within a forest or working circle. At the present time logging plans on Forest Service areas may be changed so as to cut certain heavily-infected areas earlier than originally planned, so as to reduce the insect loss. A greater knowledge of tree attractiveness and stand susceptibility will make it possible to determine the probability of insect loss when the logging plan is first drawn up, before the insect loss occurs, thus obviating the necessity of later changes, which are usually costly.

WILD ANIMAL DAMAGE TO NEW ENGLAND FORESTS

COMMITTEE REPORT[1]

New England Section, Society of American Foresters

Deer are plentiful enough in Connecticut, Rhode Island and parts of Massachusetts to do serious damage to forests by browsing. The porcupine is the most important animal damaging forests in the states north of southern Massachusetts. It clips branches and girdles the trees. Budding and cutting by rabbits, budding by red squirrels and grosbeaks and girdling by mice are much less important over the region as a whole. Cases showing the seriousness of each animal's work and control measures are given in this report, which, although prepared for a specific region has more than local interest and application.

THE OBJECT of this Committee appointed in April, 1930, was to bring together as much information as possible on damage to New England forests by deer, the rodents and birds.

Early in the work it was apparent that an exhaustive study was impossible. The damage is very variable both geographically and periodically. So it was only possible for the Committee to determine where the work of a particular species is important, how and to what species of trees damage is done, how serious the damage becomes under extreme conditions and what control measures can be recommended.

The Committee members each submitted reports on damage in their respective regions. In addition, very helpful information was given by H. I. Baldwin, K. E. Barraclough, H. O. Cook, J. H. Foster, C. S. Herr, A. W. Hurford, and H. B. Peirson. We are also indebted to the several state fish and game commissions for information on game laws, status of deer populations and the like.

The study was instituted because the damage done by deer in some sections had become a serious problem and it was thought worth while to find out how widespread it is. To complete the study for the region all animals and birds doing important damage to forests were included.

Deer

From a range practically restricted to the three northernmost states thirty years ago, this animal has increased and is now fairly plentiful in practically all rural New England. Over this whole range it is, potentially at least, an animal capable of damage to the forest, but it is only where it is very plentiful that this becomes important. In Pennsylvania where some wooded areas are practically stripped of everything eatable within reach of deer, the population was estimated as one deer to five or six acres. European experience has shown that not more than one can be kept on forty acres without damage to the forest (2). In New England, dam-

[1]Presented at the winter meeting of the New England Section, Society of American Foresters, at Providence, R. I., February 24, 1931.

age is reported as important only in Rhode Island, central and northern Connecticut and a few sections of Massachusetts.

The most important damage takes the form of browsing on the buds, leaves and tender shoots at heights below six feet and usually below four feet. In plantations of small trees the leaders are most often nipped off. In Connecticut seventy-five per cent of the trees damaged showed this type of injury. Barking of small trees while the velvet is being rubbed from the antlers is much less important than browsing although one small plantation was reported as completely ruined in this way and another was fifty per cent injured. The tree is more often deformed than killed. Deer are also said to pull newly planted trees from the ground.

All native species, coniferous and hardwood, and most exotics commonly used in the region are eaten, but tastes seem to vary between regions. In northeastern Connecticut white pine was eighty-one per cent damaged in one plantation row while the adjacent row of red pine showed only nine per cent of trees injured. In Pennsylvania Scotch pine was avoided while in southeastern Massachusetts it suffered six or seven times as much as white and red pines. The only conifer reported as immune is white spruce but this may be due to the comparatively small amounts planted. Conifers known to be eaten are white, red, pitch, Scotch and jack pine, hemlock, Norway spruce, Douglas fir and red cedar. No hardwood seems to be ignored and white ash is especially liked.

Although some browsing on tender branch tips takes place in summer, the real damage occurs in fall and winter. Most of it takes place when snow covers the ground and severe winters result in heaviest damage.

The effect on the individual tree varies widely with the degree of attack. An occasional leader nipped from a spruce has little effect while, in severe cases, growth of white pine may be almost arrested and the tree made a bunch of clipped branches.

The worst cases of stand damage in New England come from Connecticut where six observers give the following figures of the per cent of trees damaged in plantations of suitable heights:

Southeastern section	5 per cent
Northeastern section	20 per cent
Northwestern section	31 per cent

There is no important damage in southwestern Connecticut. In southeastern Massachusetts, on a game preserve, sixty to seventy per cent of two million Scotch pine were estimated as killed by deer. In the southwestern part of the state a Norway spruce plantation near old orchards has been completely ruined. Of course, small patches are occasionally badly browsed where deer yard for the winter, but over all of the country north of central Massachusetts damage was reported as either light or negligible.

In Europe deer damage is controlled by fencing, by repellents and metal guards placed on leaders and, of course, through regulating the number by hunting. The first three methods are not usable here because of the prohibitive cost, although they might have use on game preserves where it is especially desirable to establish plantations. But,

for widespread control, the state game laws must be depended on. That these are effective seems to be indicated by the comparative immunity from damage in the sections where hunting is allowed. The following table summarizes the New England open seasons on deer:

State	*Season length*
Connecticut	none
Maine	30-46 days
Massachusetts	6-12 days
New Hampshire	30-46 days
Rhode Island	none
Vermont	*10 days

*No open season in Franklin County.

One deer is the legal limit in all four states with an open season. Vermont has the only buck law. Deer damaging crops may be killed at any time in all states except Massachusetts but forest trees are not mentioned in any case as a crop. Damages for injury to crops are paid in all states except Maine and Connecticut. Deer killed while damaging crops become the property of the landowner, but in Connecticut and Rhode Island many more are thought to be killed illegally than under permits.

Any attempt to correlate damage with number of deer must be based on estimates for the regions concerned but obtaining reliable figures on the deer populations of the New England states is exceedingly difficult. No census has ever been made to show definitely how many deer are to be found and, almost without exception, no one would even hazard a guess. The only figures available are those kindly given the Committee by various state fish and game commissions on the kill of deer during the open seasons and, in Connecticut and Rhode Island, on those taken under permits. But these figures on the kill do not indicate the real deer populations. Open seasons vary both between states and between years. Hunters are more plentiful or hunting conditions more favorable in some sections than in others.

Any worthwhile estimate based on kill figures must consider the ratio of these to the total population. It was assumed that the percentage increase in kills over the last five years was the same as that for the total population.

TABLE 1.

ESTIMATED DEER POPULATION

State	Approximate deer range square miles	Annual kill	Annual kill per square mile	Per cent Annual increase above kill	State population 1931	Deer per square mile 1931
Maine	27,500	11,700[1]	.36	4	58,500	2.1
Massachusetts	6,200	2,200[2]	.32	5	11,500	1.9
New Hampshire	9,000	1,600[2]	.17	0	6,400	.71
Vermont	7,200	1,530[3]	.18	9	10,200	1.4
Connecticut	2,500	310[3 and 4]	.12	–	——	—
Rhode Island	625	100+P	.16	–	——	—

[1]1929 figure (most accurate to date).
[2]figure for 1930 from curve of last 5 years.
[3]killed on permits (damaging crops)
[4]killed by automobiles

Natural increase was taken as 25 per cent (9). Then, subtracting the yearly increase per cent from that for natural increase gave the per cent of summer population killed. And this figure divided by the per cent left after the hunting season (100+ yearly increase) gave the ratio to post-season population. And from the kill taken for 1929 from a five-year curve the 1931 populations were calculated. Table 1 gives the results.

Table 1 shows that, although deer are gradually increasing in the region as a whole where there is an open season, the number is still far below the point of danger to forests. While no real comparison can be made between Connecticut and Rhode Island and the other group, it is significant that only the deer killed while damaging crops or by automobiles and reported in these two is practically as great per square mile as through hunting in New Hampshire or Vermont, and one-third those killed in Maine. While we have no real estimate of deer population in these two states it is evidently much denser than in those to the north. It would seem that it will be necessary to reduce the number of deer in these two states to somewhere near the right densities. If this is not done, provision should be made to include young forest growth as a crop from which damages for browsing can be collected or for which the animals doing the damage can be killed.

Porcupine

This animal is found over all of New England north of southern Massachusetts and not including Cape Cod. It undoubtedly does more damage than any other animal to forests within its range.

Its habits of feeding on bark and its effective armor of quills make it independent of other animals and it increases rapidly as a result. Although bounties have been paid in the past in some of the states, most of these have been out of force for some time and the porcupine colonies have become a real factor in forest protection. The injury is most prevalent in the sections where ledges and rocks give cover. But the animal is not as particular as we might wish in this respect and, where food is available, an old building, hollow tree or log or a drain beneath a road is perfectly acceptable as quarters.

The animal is important over the Vermont mountains, all of rural New Hampshire, especially the northern part. It is said to be held down in Maine by a bounty. Massachusetts has plenty of them in the hills. The abundance in specific cases gives an idea of their ability to do damage. E. S. Bryant tells of Vermonter who, during a bounty period, visited old lumber camps sleeping daytimes and killing "porkies" nights. When the harvest fell off to ten per night he moved to another camp. A town fire warden located in central Vermont recently wrote a member of the Committee, "I think there should be some measure taken to diminish the number of hedgehogs, they are killing more trees in this town than the fire, the pests don't only trim and kill hemlocks, but gnaw girdles on spruce, beech, birch and maple trees. This gnawing bark from maple (which is our sugar maple) is something new for

hedgehogs, they didn't use to, but the cutting of so much softwood and the large numbers of them are causing many sugar orchards to be ruined." A recent examination, by the Vermont Department of Agriculture, Bureau of Insect Control, of about 200 acres of red and Scotch pine plantations scattered over the west half of the state, showed porcupine damage to 20 per cent of the Scotch pine only. Damage seemed to be confined to larger plantations. In a section near Keene, N. H., Professor Struthers of Syracuse Univercity reports that within a radius of two miles there were at least twelve colonies with fifty or more animals each and many smaller groups of a half dozen or more. In this locality Struthers trapped fifteen from one den within a week and killed nineteen by entering another den. One landowner in the town trapped over one hundred animals from his land during the winter of 1917 and paid part of his taxes with porcupine noses strung on a wire. No trapping followed for ten years when Struthers took forty-two animals during three weeks trapping and estimated that there were about twenty-five more. An area of about two hundred acres in the Harvard Forest where porcupines were particularly bad yielded thirteen animals in 1929, four in 1930, and nine in 1931.

Wherever the porcupine is found, fall and winter seasons find it living on the bark of trees. All stages of work from a sampling bite to stripping of the tree from base to tip are usually found close to the dens. The animal will bark any species of tree observed, but there seems to be a more or less definite taste in a given locality. In some places hemlock is preferred; in another hardwoods of all species are attacked and at Petersham European larch is especially relished. In this last case the animals for a distance of at least a mile from each plantation feed in it making well-beaten trails between the dens and the food supply. The animals roam more or less between dens but, unless some delicacy calls them to a distance, most of the feeding is close to the den so that dead and dying trees there are the rule. No tree from a seedling to a veteran is immune and the point of damage may be anywhere from the ground to the tip. Novel damage reported from both New Hampshire and Vermont is that of gnawing the ground wires on lookout telephones.

The effect of damage on the individual tree varies within wide limits. Cutting off branches may be severe enough to ruin the tree. Single removals of a patch of bark would often heal successfully if left alone. But the porky often returns to the same tree year after year and the callus tissue at the edge of the wound is apparently greatly enjoyed. The result is eventual girdling.

Damage to stands, too, is very variable. In extreme cases the whole stand over several acres is ruined. Foster reports a five-acre stand of pine near Keene, N. H., stripped of bark from the ground to the tips. And several acres of young hardwood ruined along a rocky ridge is not an uncommon sight anywhere within the animal's range.

The rate at which girdling takes place is surprising. Experiments with penned-up animals in Arizona (4) showed that the young ones would eat an area of

bark equal to their own superficial surface in three days. In six days one thirteen-and-a-half pound animal took three hundred square inches of bark from seventy-one seedlings and five larger trees.

Control of the porcupine is comparatively easy but expensive. The U. S. Biological Survey has developed a method of poisoning them with a salt and strychnine mixture placed in hollow wooden blocks nailed up in trees where the animals feed (3). But poisoning of any sort is illegal in all the New England states. Hunting during the winter is ineffective because the animals are usually denned up during the day. Trapping is effective, but, where the distribution is general over a considerable area, the cost is high. Massachusetts under a recently enacted law prohibits the use of steel traps except within fifty yards of cultivated land. Maine has the only bounty law now in effect and it is reported to be working well. The enactment of such a law covering other states or counties where the damage is serious would certainly be an effective means of reducing it. Since the porcupine is a recluse as far as other animals are concerned, reducing its numbers cannot influence other animal populations. The effectiveness of a bounty under the present Massachusetts trapping law is questionable.

Rabbits

Both the cottontail rabbit and the white hare included under this common name sometimes cause damage to forests. They live on the bark and buds of small, woody vegetation during winter, but are seldom numerous enough to cause serious damage. In southern Connecticut rabbits do more damage than any other animal. One case is reported from Martha's Vineyard where three acres of red and Scotch pine had every tree topped. Each state has an open season ranging from forty-six to one-hundred-fifty-one days and a daily bag limit varying from three in Connecticut to an unlimited one in Maine. We believe present hunting regulations will keep them from becoming a serious forest pest.

Red Squirrel

The red squirrel is found all over New England and, although the damage it does is inconspicuous, it is nevertheless important. Severe damage has been found in Connecticut, Massachusetts and southern New Hampshire and probably exists over all of New England. During periods of deep snow when the squirrel cannot get its usual food, it feeds on the buds of Scotch pine, Norway spruce, European larch and white pine. In Scotch pine the big buds are cut off; the green contents are eaten and the bud scales scattered on the snow. In white pine the injury is somewhat similar except that a small section of the branch or leader is usually taken off. With Norway spruce and European larch a twig tip from two to ten inches long is cut off and carried to a convenient resting place where the lateral buds can be eaten out as well as the terminal ones. The terminal bud of the spruce leader is rifled and left in place. Trees only a few feet tall are

attacked and the upper limit is unknown.

The effect on the tree varies with the species. In Scotch pine adventitious buds below the cut send out numerous branchlets forming a dense "broom." The branchlets are often repeatedly budded and the tree becomes hopeless for timber production. White pine is affected much the same but recovers somewhat better. Norway spruce leaders are replaced by the nearest lateral left untouched but the clipping of branches is often so severe that the growth in small plantations is kept almost at a standstill. On the individual tree half of the buds may be removed per winter.

Damage is, of course, most severe in small areas surrounded by woods, stone walls, apple trees, etc. In small plantings damage is uniform over the whole area often including eighty per cent of the trees. In plantations of several acres the borders to a distance of a few hundred feet are the only parts damaged. This is usually confined to the sides bordered by a favorable squirrel habitat (8).

The question of whether squirrels are beneficial in their habits of storing and eating fruits and seeds is not easily settled. They undoubtedly do bury nuts and seeds that later produce trees. But the amount of seed they consume is also important. Hatt (5) found that a pair of squirrels in captivity ate the seeds from eighty-six white pine cones in a day and from four-hundred-and-twenty-two in a week. Add to this the fact that in Petersham over sixty red squirrels were killed one fall in an old pine-hemlock stand of about twenty acres and the effect on anything but an exceptionally heavy seed crop is apparent. The squirrel population in this lot was not heavy enough to be called unusual.

Control of squirrels by poisoning is, of course, prevented by law. Trapping them with bait is easy. One of the controls suggested by Hatt (4) is that of feeding them near the plantation during the fall and winter so they will not go to the trees for food.

Mice

During occasional periods of overpopulation, mice sometimes girdle young plantations especially those of Scotch pine. One case is also reported from New Hampshire where ninety-five per cent of fifteen thousand four-year white pines were girdled. In Massachusetts a Scotch pine planting of one acre showed fifty-one per cent attacked and twenty-five per cent killed (7). Most serious damage occurs during winters of deep snow and in old field plantations although one case was reported on cut-over land.

A control measure useful prior to planting old fields is the burning of grass and weeds that afford food and shelter for mice. Traps can, of course, be used on small areas. Poisoned baits are effective. Probably the most effective control agencies are the foxes, owls, hawks, weasels, and others, that feed largely on mice.

Grosbeaks

The pine grosbeak is the only bird known to appreciably harm forest trees in the region and its effect is not very

important. While it feeds on the buds of hardwoods as well as some conifers such as European larch, it cannot cut the buds from slender branches that will not support its weight and so, on most species of older trees, there appears to be little effect on growth. There was one case reported from Connecticut in which ten per cent of a young white pine stand was damaged. Also, in southwestern Massachusetts where Scotch pine has been planted on the Granville state forest, the grosbeaks now come in flocks and bud the plantations.

Summary

1. Deer do considerable damage especially to young plantations in Rhode Island, Central and Northern Connecticut and a few sections of Massachusetts. The most important form of injury is browsing although small plantings have been ruined by rubbing of the antlers. All native species and most exotics seem to be eaten. In the four northern states with open seasons ranging from six to forty-six days deer are kept below an estimated 2.1 per square mile. The kill per square mile under permits and by automobiles in Connecticut and Rhode Island nearly equals that by hunters in Vermont and New Hampshire so the deer population must be very dense in those states. The number should be brought within reasonable limits or damages should be allowed for destruction of forest crops.

2. The porcupine inhabits all of New England north of southern Massachusetts not including Cape Cod. The animal eats the bark of all species of trees in the region usually girdling the tree and either killing or ruining it. Damage varies in intensity up to the complete loss of several acres of timber in a place. Control could be easily accomplished by poisoning but this is forbidden in all New England. Trapping is effective but expensive. A bounty is said to be working well in Maine and offers good possibilities in the other states.

3. Both the cottontail rabbit and the white hare do some damage to forests and in southern Connecticut are the worst animal pest. They are also important on Martha's Vineyard. Hunting can, in general, be depended on to keep their numbers within bounds.

4. During periods of deep snow the red squirrel eats the buds of Scotch and white pine, Norway spruce and European larch causing loss of growth and sometimes so much forking that the tree is useless. Severe damage has been found in Connecticut, Massachusetts and southern New Hampshire and in some cases the growth of small stands is held almost at a standstill by the budding. Shooting and trapping are effective controls and feeding during winter is suggested.

5. During periods of overpopulation mice occasionally girdle young plantations especially of Scotch pine. The damage is apt to occur sporadically anywhere in the region. Burning of grass and weeds before planting open land and the encouragement of predators are the best controls usable.

6. The pine grosbeak lives on tree buds during winter but the damage is slight in practically all cases. The bird cannot feed on the tips of slender

twigs and enough buds are usually left to carry on normal growth.

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EXPERIMENTAL RIBES ERADICATION STANISLAUS NATIONAL FOREST

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An example of forehandedness is the government's investigation of methods and costs of eradicating currants and gooseberries to control the blister rust disease *before* it reaches valuable stands of sugar pine in California. The work was begun none too early, for the disease has already spread to the boundaries of that state. In this article the results of initial eradication and re-eradication are compared and costs and recommendations are given. Experience indicates that present methods are so close on the way to perfection and that such further reduction in control costs may be expected as to make the protection of commercial bodies of sugar pine entirely practicable.

THE OFFICE of Blister Rust Control,[1] Bureau of Plant Industry, United States Department of Agriculture, has been engaged for the past five seasons in the experimental eradication of currants and gooseberries (the genus *Ribes*) from selected areas on the Stanislaus and Plumas National Forests, California. The purpose of the work is to develop and demonstrate methods of economically eradicating Ribes, the alternate hosts of white pine blister rust, from areas adapted to the commercial production of sugar pine and to acquire an understanding of the relation of their growth habits to control measures.

One of the major areas on which this work was done is located near Strawberry on the Stanislaus National Forest. Experimental work was conducted on this area during the three seasons of 1926, 1927 and 1930. The first two seasons were devoted to the initial eradication of Ribes from 6,670 acres of representative sugar-pine type, 3,134 acres being worked in 1926 and 3,536 acres in 1927. In 1930 the work consisted of a second eradication to determine to what extent new bushes and bushes missed during the first working were re-populating the area. The work in 1926 was located on the upper drainage of the North Fork of the Tuolumne River in township 4 north, range 18 east. The 1927 area joined the 1926 area on the north and included parts of the drainages of the South and Middle Forks of the Stanislaus River in the same township.

The topography of the region is characterized by moderately sloping ground cut by the steep canyons of the main drainages. Elevations vary between 5,000 and 6,000 feet. The two chief timber types are sugar pine-yellow pine and sugar pine-white fir.

The area on which eradication work was done was divided on the basis of Ribes, brush and timber conditions into eradication types. The following four types were recognized:

(1) Sugar pine-yellow pine type

[1]In coöperation with the U. S. Forest Service, the California State Department of Agriculture, the California State Board of Forestry, and the University of California.

(SP-YP), generally open in character and containing relatively few Ribes.

(2) Sugar pine-white fir type (SP-F), generally having an abundance of white fir reproduction, varying amounts of different species of brush, and numerous Ribes.

(3) Brush type, consisting of openings in the timber stand resulting from fire, on which a temporary cover of brush occurs, usually abundantly populated with Ribes.

(4) Stream type, or the narrow strip of moist land along water courses on which Ribes are generally present in profusion.

Each eradication type was subdivided into blocks, or working units, of convenient size to facilitate crew work.

Eradication crews consisted of from 3 to 5 men, depending upon working conditions. Crewmen were equipped with a special pick-mattock-type grubbing tool. Crews, proceeding in a modified echelon formation and guided by white string lines, systematically covered each block, grubbing Ribes as found. Spacing between the men was varied between 8 and 80 feet, according to the abundance of Ribes and their visibility in the locality.

Each season such matters as the most effective size and formation of crews, the most effective tools for eradicating Ribes, the most efficient size for camps, and the best methods for cheaply eliminating from crew work areas free of Ribes were the subjects of experimentation. As a result of these experiments the 3-man crew was adopted as being the most satisfactory for general working conditions. A special pick-type mattock, weighing, complete with handle, approximately 7 pounds, was the most effective eradication tool. Eradication camps of 20 men were most efficiently administered and supervised. Areas free of Ribes were located and blocked out in advance of crew work by systematic Ribes cruises or prechecks.

Four species of Ribes were found indigenous to the areas worked. They were *Ribes roezli* Regel, constituting 80.8 per cent of the total bushes eradicated, *Ribes nevadense* Kellogg, 19.1 per cent, *Ribes hallii* Jancz and *Ribes cereum* Douglas 0.1 per cent. *Ribes roezli*, the prickly-fruited gooseberry, occurred in all types. *Ribes nevadense*, the Sierra Nevada currant, was confined chiefly to streams and moist spots. *Ribes hallii*, the sticky currant, and *Ribes cereum*, the squaw currant, were found only occasionally near the summits of the higher ridges.

The results of the two seasons of initial eradicative work are shown in Part A of Table 1, segregated according to logged and unlogged areas into eradication types. Variations in Ribes present in the different types are clearly shown, stream type containing the greatest number, sugar pine-fir a less amount and sugar pine-yellow pine the least, both for logged and unlogged areas. In the same order these types have decreasing amounts of moisture present in the soil. Available soil moisture may therefore be the factor most operative in controlling the distribution and growth of Ribes for this locality of the sugar pine belt.

Eradication costs increase as the number and the size of Ribes increase and as working conditions become more

difficult. Unlogged sugar pine-yellow pine type with fewest bushes and easiest working conditions has the the lowest cost of $0.44 per acre (1926 area). For sugar pine-fir type, where more bushes occur and undergrowth is more prevalent the cost is $1.97 per acre, while for stream type, which has the greatest number of Ribes per acre and usually the most difficult working conditions, the cost is $4.54 per acre. Eradication costs for the brush type are usually high because of the difficulty involved in locating and removing Ribes from such areas.

On the 1926 unit an average of 59 Ribes per acre was removed at a cost of $2.22. On the 1927 unit there were 60 Ribes per acre eradicated at a cost of $2.00. Cost reductions in 1927 were

TABLE 1.

SUMMARY OF FIRST AND SECOND ERADICATIONS

Eradication type		Part A First eradication: Acres	Ribes per acre	Costs per acre	Part B Re-eradication—1930: Acres	Ribes per acre	Costs per acre
1926 Unit							
Unlogged	SP-YP	790	8.0	$ 0.44	340	0.9	$0.04
	SP-F	1,091	36.0	1.97	36	7.8	0.25
	Stream	301	109.0	4.54	75	93.9	0.90
	Brush	250	106.0	4.69	Logged since 1926		
	Ribes free	125	0.5	0.09	Not Re-worked		
Logged since 1926	SP-YP				450	8.0	0.64
	SP-F				951	38.8	0.93
	Stream				176	130.4	1.97
	Brush[1]				195	50.2	2.70
Logged Before 1926	SP-YP	346	37.0	1.99	301	12.5	1.03
	SP-F	144	151.0	3.64	26	33.5	3.49
	Stream	87	504.0	7.89	75	76.9	2.66
Totals or averages		3,134	59.0	$ 2.22	2,625	34.8	$1.04
1927 Unit							
Unlogged	SP-YP	990	7.0	$ 0.49	Logged since 1927		
	SP-F	354	38.0	1.89	Logged since 1927		
	Stream	75	80.0	3.96	Logged since 1927		
Logged since 1927	SP-YP				990	3.1	$0.21
	SP-F				354	44.8	1.21
	Stream				75	276.7	2.90
Logged before 1927	SP-YP	1,133	31.0	0.91	1,044	8.8	0.32
	SP-F	909	111.0	3.88	662	41.4	1.67
	Stream	75	642.0	13.81	75	178.3	3.11
Totals or averages		3,536	60.0	$ 2.00	3,200	28.0	$0.79
Both Units							
Totals or averages Both years		6,670	59.5	$ 2.12	5,825	31.0	$0.90

[1]Had an over-story of scattered timber.

largely the result of improvements in eradication methods and a better understanding of working conditions.

The unshaded bars in Figure 1 compare the numbers of Ribes and the costs per acre by types for logged and unlogged areas.

The influence of logging causing an increase in Ribes per acre and a concomitant rise in eradication costs is shown in Figure 1. On the 1926 unit the areas logged were cut selectively about 16 years before the first eradication. Logging on the 1927 unit took place largely in 1923 and from 1925 to 1927, a much younger cut. Disturbances to the soil and cover types attending logging, such as the exposure of mineral soil, the removal of the forest canopy admitting more sunlight to the ground, and alterations in the soil moisture, are conducive to Ribes germination and growth.

Re-eradication

By 1930 a sufficient number of new Ribes had appeared on the original eradication areas to warrant a second working of these units. Studies were accordingly undertaken to ascertain Ribes conditions and re-eradication costs 3 and 4 years after the initial eradication. A total of 5,825 acres, consisting of 2,625 acres on the 1926 unit and 3,200 on the 1927 unit, were re-worked in 1930, portions of both areas being omitted because of insufficient time. This accounts for the disparity in total acres between the first and second eradications in Table 1.

In general the methods of work were similar to those employed during the 1927 eradication except that 3-man crews were used exclusively on all types, that size having been found the most efficient. All of the original eradication blocks were not re-worked by the usual crew method. It was found that parts of the sugar pine-yellow pine types contained practically no Ribes, hence it was not necessary to send crews into them. A checker was sent into areas suspected of containing a paucity of bushes to determine their number and occurrence. He was followed by one or two men who cleaned out the patches if only a few were found. This eliminated a large amount of crew work. Records were kept of bushes by species and according to origin, *i. e.*, seedlings, or bushes originating since the first eradication; sprouts, or bushes not completely removed at the time of the first working; and missed bushes, or those not found the first time. Size measurements, expressed in feet of live stem, were taken for each brush recorded. Notations were also made as to whether or not bushes were fruiting.

A fact of importance regarding both units, the consideration of which continues throughout the discussion, is that the areas have been materially altered by logging since the initial working. It has been necessary, in order to compare comparable areas of the first and second eradication, to divide the areas into three groups: those unlogged at the time of the first working, those logged prior to that date, and those logged since. This was done in Tables 1 and 2. It is seen from Table 1, 1926 unit, that the greater part of the "Unlogged" class has been cut over since 1926 and hence falls in the cut-over category. The

TABLE 2.

BUSHES AND LIVE STEM REMOVED BY RE-ERADICATION SEGREGATED ACCORDING TO BUSH CLASS

Eradication type		Acres	Ribes per acre: Seedlings Bushes	Seedlings F. L. S.[1]	Sprouts Bushes	Sprouts F. L. S.	Missed Bushes	Missed F. L. S.	Total Bushes	Total F. L. S.
1926 area										
Unlogged	SP-YP	340	0.5	3.0	0.2	1.0	0.2	8.0	0.9	12.0
	SP-F	36	4.5	14.2	2.3	51.0	1.0	32.4	7.8	97.6
	Stream	75	90.7	96.8	2.1	15.8	1.1	30.6	93.9	143.2
Logged since 1926	SP-YP	450	6.7	40.3	1.0	30.8	0.3	25.1	8.0	96.2
	SP-F	951	35.6	83.4	2.6	30.9	0.6	18.6	38.8	132.9
	Stream	176	121.4	114.9	7.6	73.8	1.4	36.3	130.4	225.0
	Brush	195	25.0	29.1	10.9	55.2	14.3	178.9	50.2	263.2
Logged before 1926	SP-YP	301	8.3	18.6	3.1	48.0	1.1	48.5	12.5	115.1
	SP-F	26	22.0	55.7	9.3	136.0	2.2	109.8	33.5	301.5
	Stream	75	60.8	88.7	12.6	144.0	3.5	119.8	76.9	352.5
Totals or averages		2,625	29.7	56.0	3.4	38.0	1.7	39.0	34.8	133.0
1927 area										
Logged since 1927	SP-YP	990	2.5	22.5	0.3	5.5	0.3	13.7	3.1	41.7
	SP-F	354	41.7	106.0	2.2	22.2	0.9	22.1	44.8	150.3
	Stream	75	272.3	377.4	3.4	27.5	1.0	28.6	276.7	433.5
Logged before 1927	SP-YP	1,044	7.8	128.7	0.6	12.5	0.4	33.6	8.8	174.8
	SP-F	662	34.6	305.2	3.7	47.9	3.1	117.1	41.4	470.2
	Stream	75	172.4	372.0	4.0	44.0	1.9	64.2	178.3	480.2
Totals or averages		3,200	25.5	141.0	1.5	20.0	1.0	44.0	28.0	205.0
Both areas										
Totals or averages		5,825	27.4	103.0	2.3	28.0	1.3	42.0	31.0	173.0

[1]Feet of live stem.

acreage figures opposite "Logged Before 1926" would have been identical for both operations had the same amount of territory been covered by re-eradication. The same considerations hold for the 1927 unit.

An average of 31 bushes and 173 feet of live stem per acre were removed by the second eradication at an average per acre cost $0.90. Part B of Table 1 gives the distribution of Ribes and shows the cost for the areas according to logging status and eradication types. In Table 2 the distribution of Ribes separated into the three classes of seedlings, sprouts and missed bushes is similarly shown. Eighty-eight per cent of the bushes found by the second eradication are seedlings having their origin since the first eradition, 8 per cent are sprouts and 4 per cent are missed bushes. The seedlings, however, have only 60 per cent of the live stem, the sprouts 16 per cent and the missed bushes 24 per cent.

Figure 1 is a graphic comparison of costs and numbers of Ribes per acre of the first with the second eradication for both units. For the 1926 unit the average number of bushes per acre fell from 59 in 1926 to 35 in 1930, and the cost from $2.22 to $1.04 per acre. In the "Unlogged" and "Logged Before 1926" groups the number of bushes had fallen off materially in 1930, but in the "Logged Since 1926" group there is a general increase in bushes. Many of these bushes are of recent germination and their average size in feet of live stem is smaller than those in the older cutting, though greater than for the uncut group. This plainly shows the influence of logging on Ribes establishment even in the face of an eradication performed prior to logging.

Since data for the same areas are compared in the figure, it is seen that in the "Logged Since 1926" group the 1930 data are compared with data taken on the same areas in 1926, which were, of course, unlogged at that time. The immediate influence of logging is lost in the "Logged Before 1926" group because the old age of the cutting has resulted in a stalibization of the Ribes flora, hence no increase in bushes per acre is found in this group. The effect of logging is again seen when comparing the re-eradication figures for the "Logged Since 1926" group with those for the "Unlogged", the Ribes and costs being higher in the "Logged Since 1926" group. Since most of the cutting was recent, its full effects had not yet developed. The 1927 diagrams show in general the same points.

In the chart depicting costs per acre for both units, it is seen that, with one exception, re-eradication costs are less than initial eradication costs. As logging increases the number of Ribes, so does it increase the cost of eradication, since the latter is in large measure a function of the former. This can be seen from the higher costs for the two logged classifications of the 1926 unit over the unlogged. For the older cutting the costs are greater than for the younger cutting, even though the number of Ribes was greater in the latter. The heavy undergrowth of brush on the older cuttings and the larger size of the bushes with more tenacious roots occurring interwoven with the roots of the brush result in high eradication costs and explain this apparent anomaly. On

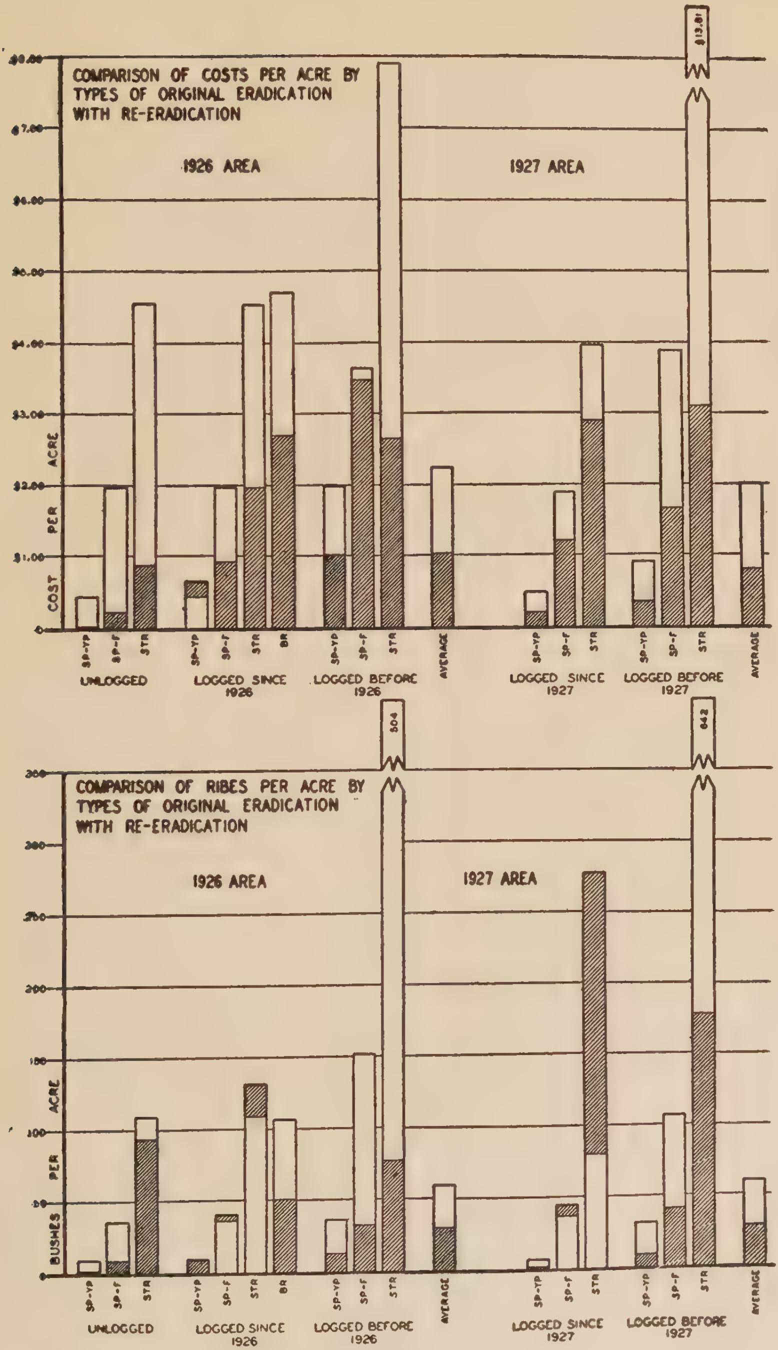

Fig. 1.—Comparisons of number of Ribes per acre and costs per acre by types of original eradication with re-eradication.
Note: Unshaded Portion Denotes First Eradication. Shaded Portion Denotes Second Eradication.

logged areas Ribes become established before the associated species of brush, hence on young cuttings visibility is good, the Ribes are small and less firmly rooted, and consequently less expensive to remove than on older cuttings. The 1927 section of the graph sustains these conclusions.

On the 1926 area there was originally an average of 59 Ribes per acre as against 34.8 found by re-eradication. On the 1927 area there was originally an average of 60 Ribes per acre, whereas re-eradication showed 28. The apparent explanation for the larger number of bushes occurring on the 1926 area is the difference in the time of eradication on the two areas. Four years had elapsed before re-eradication on the 1926 area and only 3 years on the 1927 area. Other factors such as the time and degree of logging on each unit have probably influenced this result.

A significant thing brought out by these comparisons is the reduction in re-eradication costs to less than half of the original costs. Cost reductions would have been greater had no logging operations occurred. These figures should not be considered as representative of the general sugar pine region. Costs obtained for one locality are not directly applicable to another. Abundance of Ribes, ground cover, topography and accessibility of the country are items entering into costs. These conditions vary considerably throughout the wide latitude of sugar pine. Also, as further refinements in eradication methods, development of possible chemicals toxic to Ribes, and a better understanding of Ribes growth habits are attained, costs will be lowered.

A question regarding the performance of eradication with respect to the time of logging might well be asked here. When can an eradication job be most effective, before logging or after logging, and how long before or after? A final answer will not be known until a complete knowledge of Ribes growth habits is available. However, eradication studies on two similar adjacent areas of the 1927 unit have provided some information on this question. On one Area 1 eradication work had been done in 1927 and logging had taken place immediately after. The other Area 2 also logged in 1927, had had no work done upon it in 1927. In 1930 re-eradication was done on the former and an initial eradication on the latter. Table 3 gives a comparison of costs and the number of Ribes per acre for these two areas.

While no broad conclusion can be drawn from this comparison, these data indicate that an eradication operation should be delayed until after logging if an area is scheduled to be logged within a few years. In every case it is seen that the per acre costs for Area 2, where one eradication followed logging, are lower than the combined costs of eradication and re-eradication for Area 1. The average number of Ribes per acre is less on Area 2 than on Area 1, although there is a greater number in the stream type of Area 2.

Information was obtained on the average yearly rate of growth of Ribes during the early years of their existence. The amount of live stem was measured and the age or each bush on the three principal cut-over eradication types. Bushes ranged from those of the current

TABLE 3.

RELATION OF THE TIME OF ERADICATION TO LOGGING

Area	Time of eradication	SP-Fir type Acres	Ribes per acre	Costs per acre	Stream type Acres	Ribes per acre	Costs per acre	Average Acres	Ribes per acre	Costs per acre
#1	Just before logging	169	61	$2.22	35	90	$3.85	204	66	$2.50
#1	Reworked 3 years later	169	87	1.69	35	563	3.69	204	168	2.03
#1	Total for area 1	169	148	$3.91	35	653	$7.54	204	234	$4.53
#2	First eradication 3 years after logging	175	135	$2.30	10	1,299	$6.18	185	198	$2.51

Area 1—Ribes eradicaion in 1927, reworked in 1930.
Area 2—Ribes eradication in 1930, no reworking.

eason to an age of 4 years, beyond hich exact ages could not be accurately etermined. Bushes older than 4 years ere designated as "Present Before Logging", since 4 years antedated the ogging operations on the areas studied. hese figures are averaged and presented in diagram form in Figure 2, and e numbers of bushes forming the basis or the figure are shown in Table 4.

TABLE 4.

UMBER OF BUSHES FORMING BASIS FOR CHART 2

Age of bush years	*Ribes roezli* Number of bushes SP-F	SP-YP	Stream	*Ribes nevadense* bushes Stream
1	122	832	420	1,471
2	415	751	457	1,936
3	366	120	386	718
4	83	60	134	68
resent before logging	164	755	250	45

Although *Ribes roezli* is a drought-esistant species and occurs on the hot outherly exposures on the sugar pine-ellow pine types, it attains its greatest ze and best development on the cooler ugar pine-fir slopes. It is not priarily a stream type species and hence should not be expected to attain optimum growth there, where moisture evidently does not compensate for reduced sunlight and the more competitive conditions of a denser ground cover. Data depicting rate of growth of *Ribes nevadense*, especially for the older bushes, are probably insufficient to fully evaluate the rate of growth the species is capable of making in stream type.

In order to ascertain the percentages of seedlings, sprouts, and missed bushes bearing fruit, data on this point were taken when the bushes were pulled. This study also revealed that Ribes do not begin fruiting until the third year and then but sparingly. Abundant fruit production may take place the fourth year if conditions are favorable. Table 5 shows by type and logging status the percentage of Ribes of each class producing fruit.

It is clearly seen that fruit production is least in the unlogged areas where sunlight is reduced and growing conditions are less favorable to Ribes. No seedlings produced fruit there. A higher percentage of Ribes were fruiting on the 1927 unit than on the 1926, although the reverse might have been expected

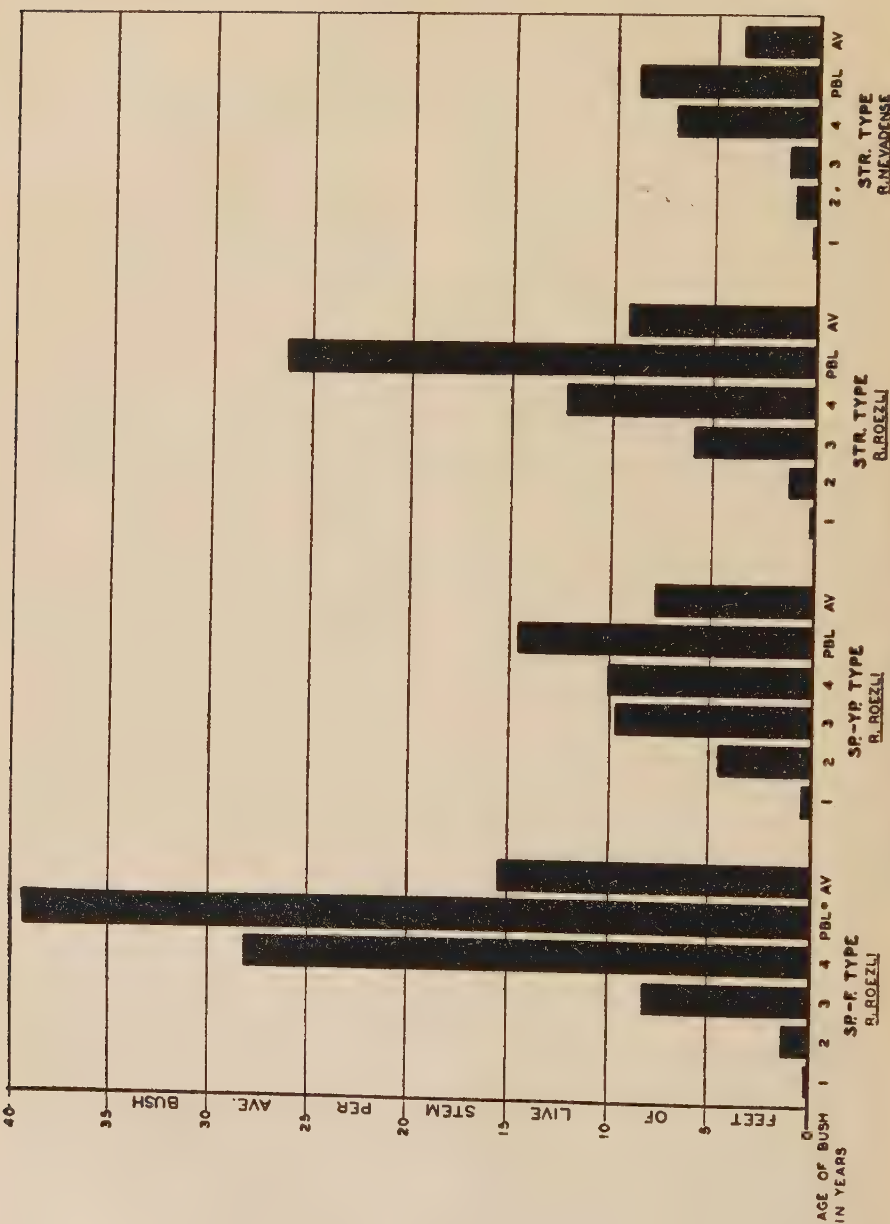

Fig. 2.—Growth of Ribes on cut-over areas.
NOTE: PBL—Present before logging, 5 years and older.

TABLE 5.

PERCENTAGES OF BUSHES FRUITING

Eradication type		Percentages of bushes fruiting: Seedlings	Sprouts	Missed
1926 area				
Logged	SP-YP	1.3	24.3	41.5
	SP-F	0.6	13.0	22.4
	Stream	0.1	13.8	28.2
	Averages of types	0.7	17.0	30.7
Unlogged	SP-YP	0.0	6.8	40.6
	SP-F	0.0	4.6	7.8
	Averages of types	0.0	5.7	24.2
1927 area				
Logged	SP-YP	8.0	26.4	50.4
	SP-F	4.1	20.6	29.7
	Stream	0.3	14.6	31.3
	Averages of types	4.1	20.5	37.1

since the 1926 eradication is the older. This disparity is probably due to the higher percentage of 1929 and 1930 cuttings on the 1926 unit which were too recent to permit full Ribes development. The 1926 area therefore had more one and two-year-old seedlings which do not produce fruit, and the sprouts and missed bushes had not been released long enough to fruit abundantly.

Re-eradications must be correlated with the age at which seedlings fruit and the time after eradication when germination of seed that may be stored in the duff ceases. On this latter point complete information is lacking which subsequent studies will supply. Fruiting 3-year-old bushes, as well as numerous 1930 seedlings, found on parts of the eradication area, are evidence that these factors were operating. Seed was being produced by the new plants before all stored seed had germinated. The abundance of 1930 seedlings could not well be accounted for by the small number of fruiting sprouts or missed bushes found on the eradication areas, nor could the fruiting seedling group be responsible since but a small number were fruiting, and they for the first time. A third eradication will therefore be needed on certain sites on these areas before permanent Ribes suppression will be secured.

The cost of the third eradication should be considerably less than the second. Much of the area will not need another working. Fruiting bushes have been practically eliminated. The cost of the second eradication was less than half that of the first, and it is reasonable to assume that the third eradication will cost less than the second.

The experimental eradication of Ribes has resulted in what is now felt to be a satisfactory degree of efficiency, which is the elimination of from 89 to 95 per cent of the original number of bushes and from 95 to 98 per cent of the Ribes live stem. It is recognized, however, that the final criterion for protective measures is the damage that will result from given amounts of bushes or live stem left on an area. Careful technical studies of the susceptibility of the California species of Ribes, and accurate evalua-

tion of their power to cause infection on sugar pine as it occurs in nature will be necessary before the question of the requisite degree of efficiency of Ribes eradication can finally be answered.

This experimental work has shown that, in the localities concerned, an unlogged area of sugar pine type will contain fewer Ribes and will represent a lower protection cost than a logged area. Also, that the sugar pine-fir type contains more Ribes than the sugar pine-yellow pine type. Logging, by the production of favorable conditions for Ribes germination and growth, increases the Ribes flora and eradication costs rise correspondingly. The cost of re-eradication is less than half that of the first work. The number of Ribes eradications needed to insure permanent protection to pine will vary according to these conditions. One eradication may suffice on much of the sugar pine-yellow pine slopes and several eradications be needed for the more favorable Ribes sites. The stream type, or narrow belt of moist land along streams contains the greatest number of Ribes and may represent a focal point of danger as blister rust begins to invade the sugar pine belt.

CAN THE COST OF BLISTER RUST CONTROL BE JUSTIFIED?

By ELERS KOCH

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Now that the white pine blister rust has definitely shown its virulence and potential danger in the West, and control methods and costs are known within limits, the huge problem of actually effecting control directs forcible attention to the justification of the expense. The author discusses the business side of control measures for both federal and private forest lands. The government cannot afford *not* to protect its white pine from blister rust; it is not so easy to demonstrate the business feasibility on private lands. Protection on private land is the most urgent and difficult forestry problem. The author believes large-scale federal acquisition and protection to be the solution.

THERE is an old adage that you cannot make an omelet without breaking eggs. I can imagine that the average housewife who is quite accustomed to cracking a dozen eggs for a family omelet would be quite appalled at the number of eggs to be broken into the pan if she were suddenly required to make omelets for a thousand people.

The unaccustomed magnitude of the white pine blister rust control job confronting us in Idaho hits a good many foresters in about the same way. So long as the work went on in a small-scale experimental way we were not disturbed very much, but now that we are faced with an immediate program involving the expenditure of six or seven million dollars in the western white pine region within the next ten years, it behooves those responsible for the program to convince themselves and others that the cost justifies itself as a business proposition. It is not only the cost in dollars that is a bit staggering, but the facing of the physical job of eliminating all the currant and gooseberry bushes on three million acres of wild land is enough to cause one to take several looks at the whole card.

The blister rust control office has estimated from extensive experimental work that *Ribes* eradication in the western white pine type will average about $2 per acre for the first operation and around 7.5 cents per acre per year for subsequent work.

There has not been the opportunity to observe the destructive effect of uncontrolled blister rust infection on western white pine stands over long periods of time, but the disease is proving to be so much more virulent on western white pine than on the eastern species that the conclusion seems justified that unprotected young stands of pine will be practically destroyed before reaching maturity.

Without white pine, profitable forestry in the white pine region of northern Idaho is "sunk." It is a region of high logging costs and high protection costs, and the bulk of its product must be transported long distances to market. The spread in lumber values between white pine and its principal associates, Douglas fir, larch, white fir and hemlock, has for years been maintained at from $15 to $20, occasionally going as high as $25. White pine alone has

made the lumber industry possible in this region. There seems to be no sound reason for believing that this ratio will be altered in the future. The soft pines, with their many valuable properties, are being depleted more rapidly than the great group of species which compete for general construction purposes but which lack many of the soft pine properties.

From the viewpoint of the federal government, committed to the policy of permanent management of the national forests, it is easy to demonstrate that the government cannot afford *not* to protect the white pine from blister rust. It is not so easy to demonstrate that a private owner not committed to permanent forest management can afford to protect his pine.

A few cost figures will illustrate the point. Suppose we take a 30-year-old stand in the white pine type, which represents about the average age of most areas of second growth in the region. If protected from blister rust such a stand would produce at the age of 100 years, as a conservative average, 30,000 feet per acre, at least one-half white pine. Stumpage values by that time should certainly equal top prices during the last ten-year period, which would be around $10 per 1000 board feet, for white pine and $2 for other species. This would produce a value of $180 per acre, which is considerably less than some areas in the national forests have already brought in the open market.

If the white pine were destroyed by blister rust, the final yield would doubtless be reduced. It would be replaced only in part by other species. The yield might be figured at 20,000 board feet per acre, with a value of $40 per acre.

The cost per acre to bring such a stand to maturity on the national forests would be about as follows:

Original *Ribes* eradication $2—70 years at 4 per cent interest	$31.14
Subsequent cost 7½ cents per acre per year—70 years at 4 per cent interest	27.32
Fire control 10 cents per year—70 years at 4 per cent interest	36.42
Total	$94.88

With blister rust control we have cost at end of rotation, including 4 per cent compound interest $94.88 per acre, stumpage value per acre, $180; net return, $85.12.

Without blister rust control the cost is limited to fire control, which amounts to $36.42 per acre, stumpage value, $40 per acre; net return, $3.58.

In other words, we barely break even without the blister rust control, and with it have a considerable profit over 4 per cent interest.

So much for national forest land. In the case of private land, assuming the land is listed under the forestry tax law of Idaho, we would have to include 4 cents per year taxes, and reduce the final returns by 12.5 per cent for yield tax. Also interest on the land value must be included. About the only market for second growth or cut-over lands is through exchange with the U. S. Forest Service, which might produce a value of $2 per acre. The cost and returns on private land would be as follows:

Blister rust and fire control, same as national forests	$94.88

Taxes 4 cents per year with 4 per cent interest for 70 years	14.57
Interest on land value of $2— 70 years at 4 per cent	29.14
Total	$138.59
Returns, $180 less 12.5 per cent	$157.50
Net profit over 4 per cent	$18.91

The private land in this example will thus yield a little better than 4 per cent compound interest, if protected from blister rust. Without protection it would be useless to hold such lands. Much of the privately owned land in Idaho will produce considerably better yields than the figures used, and there is always the chance that white pine stumpage may be worth double the amount assumed. Immature stands older than 30 years will of course make a better financial showing, and younger stands not so good.

The Forest Service is definitely committed to a program of *Ribes* eradication over the major portion of the white pine type in the national forests of Idaho and western Montana. The 10-year plan provides for treating 1,293,000 acres at an estimated cost of $3,377,000. Appropriations for 1930 amount to $195,000, which will permit a large-scale operation.

The prospects for protection of 1,200,000 acres of private land in the region are none too good. Several of the larger timber land owners are embarking on a blister rust control program in cooperation with the federal government, but there is a vast area including some of the best white pine land in Idaho which is held by owners who are definitely not in the timber growing business, on which prospects for control work are not promising. The ultimate disposition and protection of this land is the most urgent and difficult forestry problem in the Inland Empire region. Protection of this area from blister rust is even more pressing than protection from fire. The loss from fire is only an annual toll, but a few years of uncontrolled blister rust infection may do irreparable damage to all of the young white pine in this region. The only solution which appears to be possible within the limited time available is a large-scale program of federal acquisition and protection.

FOREST FIRE PROTECTION—A NATIONAL INTEREST

By FRED MORRELL

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In this article Mr. Morrell discusses the fundamental basis on which federal contribution toward forest fire protection rests. An interesting tabulation of the various factors, urged as a basis of contribution to the states, is used to show that certain bases would be unsatisfactory while others are fundamental. These and other facts are used to prove that federal contributions should be based on national interests in forests as sources of raw material and protectors of drainage and recreation areas.

IN A discussion of the subject of federal assistance in protection of state and privately owned forest lands with a group of Southern California business men some months ago, one of those present stated with some heat that the residents of that portion of the state paid a certain percentage of all federal taxes, and that they were, therefore, entitled to receive most liberal consideration in the allotment of funds. At about the same time a well-informed citizen of Pennsylvania and an irate state official of Massachusetts made similar claims for considerations of their states.

There is, of course, no correlation between the amount of federal taxes paid in a state and its needs for forest fire protection. If federal money were allotted on such a basis, then Nebraska and some other states which have no forests to protect would receive a goodly share. And if each state were to receive back from the federal government the same proportion of the funds appropriated that it pays in then there would be little point in making the project a federal one at all. But before discussing that, there is the question, "Who pays the taxes anyway?" It would seem that in the end most of them must come from the consumer. Yet gentlemen from the larger tax-paying states or from trade or industrial regions frequently lay claim to large consideration for the taxes which they pay and pass on to the users of the products in which they deal, a large percentage of whom may live across the continent.

Probably the most accurate general indicator of the financial support given to the federal government by a state is the volume of its retail trade because that is the measure of what percentage its citizens consume of the total goods on which federal taxes are paid. Likewise, the real source of private or corporate income tax is not where the individual who pays it resides or where the offices of the corporation are located, but where the consumers live who use the goods from which income is dederived.

The discrepancies between volume of retail trade and federal taxes paid by citizens in the several states are brought out in Table 1. New York pays over 35 per cent of all federal taxes, but has only thirteen per cent of the retail trade. North Carolina pays nearly eight per cent of all federal taxes with slightly over one and one-half per cent of the re-

tail trade, while Idaho's percentage of the retail trade is eighteen times its percentage of federal taxes paid. Obviously, New York importers who pay more than half of all customs duties, and North Carolina producers of smoking materials are getting some of their tax money from consumers of their wares who live in Idaho.

But it is not the intention in this article to discuss the general tax question further than is necessary to explain why volume of retail trade is used rather than direct source of federal taxes as a basis for comparing benefits received with amounts contributed by the several states in the national forest program. Briefly, this program which was established by what is known as the Clarke-McNary Act of June 7, 1924, provides that the federal government will contribute a like share of the total cost of protecting state and privately-owned forest lands in each state from fire. Column 3 of Table 1 shows each state's percentage of the total estimated cost for protecting all forest lands in the country. It will be noted that the figures in this column differ radically from those in column 2 representing the percentage of total retail buying power. That, as indicated above, would be expected because forest lands do not support large populations, and while the per capita purchasing power differs materially in the several states, a large retail purchasing power cannot exist without large numbers of people.

Federal participation in forest production is based on the theory that no state is or can be self-supporting in its forest needs because regardless of how much it produces it will find it necessary to import from other states species better adapted for some purposes than those that are grown in the state, or timber from a nearby state may be more accessible to some points of consumption than that grown at home. Thus, Louisiana, although a large exporter of forest products ships from other states nearly one-third of all the sawed lumber which it uses. Likewise, forestry has a national aspect because forests growing in one state may be of equal or greater importance from the standpoint of stream regulation and erosion control to other states than to the one in which they are located.

Column 4 of the table gives the amount of sawed lumber derived by each state from other states in the year 1928. Sawed lumber is, of course, not the only forest product that is shipped between states, and if all wood products were included the comparisons that follow would be materially changed in some of the states. But the single item will serve to illustrate the point that forestry has an important national aspect, and that the policy of the federal government contributing an equal share of the cost of protecting forests from fire in each state is sound, and substantially fair to all of the states. Referring to column 2 of the table, it will be noted that the states which, measured by retail buying power, pay the largest percentages of federal taxes are New York, Pennsylvania, Illinois, Ohio, California, Massachusetts, and Michigan in the order named. Referring to column 4, we find that all of these states except Massachusetts derived in 1928 more than a billion feet of sawed lumber from other states, and that none of the other

TABLE 1

BASIC DATA FOR DETERMINING FEDERAL CONTRIBURION TO STATES FOR FIRE PROTECTION

State	Per cent of all U. S. tax and customs paid by each state	Percentage of U. S. total retail buying[1]	State's percentage of estimated total cost to protect all state and privately owned forests from fire	Sawed lumber derived from other states 1928 1000 feet board measure	Per cent of lumber used in 1928 that was derived from other states	State's percentage of all forest and potential forest land[2]
	(1)	(2)	(3)	(4)	(5)	(6)
Ala.	0.21	1.41	4.29	174,498	33.17	5.45
Ariz.	0.13	.33	——	42,333	50.08	——
Ark.	.09	1.06	3.75	110,939	27.68	5.35
Calif.	4.65	5.27	5.25	2,055,048	66.19	3.16
Colo.	.35	.95	——	185,476	81.31	——
Conn.	1.36	1.66	.57	232,767	77.57	.36
Del.	1.10	.23	.09	41,955	87.16	.08
Fla.	.57	.99	6.34	22,911	5.51	5.57
Ga.	.53	1.78	5.80	119,344	32.72	5.62
Ida.	.02	.36	3.49	67,203	31.74	1.12
Ill.	7.20	7.51	.58	2,236,314	95.44	.67
Ind.	.73	2.42	.63	753,617	90.01	.73
Iowa	.37	1.82	——	540,395	94.06	——
Kans.	.47	1.37	——	404,201	99.49	——
Ky.	.86	1.59	1.80	393,410	87.07	2.19
La.	1.15	1.28	3.25	229,783	32.46	4.36
Me.	.27	.63	2.56	54,962	20.96	3.64
Md. & D. C.	1.79	2.09	.55	503,389	89.98	(Md.) .54
Mass.	4.26	4.41	1.26	627,141	69.06	.80
Mich.	3.91	4.03	5.26	1,162,033	67.78	4.53
Minn.	.89	2.01	5.21	533,844	73.55	5.00
Miss.	.06	.97	4.21	44,097	10.11	4.75
Mo.	1.79	2.80	2.59	678,959	89.06	3.83
Mont.	.08	.58	1.75	74,164	27.81	1.18
Nebr.	.17	1.05	——	303,770	97.77	——
Nev.	.05	.11	——	53,539	99.81	——
N. H.	.10	.41	.98	67,535	29.90	1.04
N. J.	3.40	3.59	.96	665,869	79.78	.46
N. M.	.02	.25	.19	47,125	42.83	.44
N. Y.	35.34	13.17	2.83	2,486,134	80.51	2.85
N. C.	7.76	1.65	4.73	206,229	33.26	5.01
N. Dak.	.04	.41	——	136,711	96.73	——
Ohio	4.12	5.65	.45	1,383,251	90.87	.53
Okla.	.49	1.42	1.23	346,644	75.97	3.02
Ore.	.20	.83	4.80	86,151	8.25	2.60
Penn.	7.80	8.99	2.72	1,534,379	87.18	3.01
R. I.	.47	.63	.13	151,626	94.59	.07
S. C.	.10	.97	2.83	25,104	19.81	3.04
S. Dak.	.02	.48	.03	137,840	79.05	.02
Tenn.	.46	1.52	1.83	563,116	70.20	2.54
Tex.	1.41	3.56	3.25	723,643	45.57	3.81
Utah	.09	.41	——	120,443	94.05	——
Vt.	.12	.30	.43	25,487	21.84	.82
Va.	2.82	1.57	2.97	293,154	64.90	3.41
W. Va.	.33	1.56	2.33	117,422	49.89	2.25
Wash.&Alaska	.56	1.22	5.16	153,832	9.03	(Wash.) 2.94
Wisc.	1.00	2.46	2.92	561,165	54.46	3.21
Wyo.	.02	.25	——	110,586	82.12	——
Hawaii	.15	——	——	——	——	——
Philippines	.06	——	——	——	——	——
Porto Rico	.06	——	——	——	——	——
Totals	100.	100.	100.	21,589,538	64.52	100.

[1]From *Editor and Publisher*, November 23, 1929.
[2]Does not include federally-owned lands.

states got into billion feet figures. On the other hand, states which will, if the national program of forest protection is carried out, receive relatively high percentages of total federal funds, such as Florida, Georgia, Oregon, and Washington are generally found to be small importers of lumber. Similar comparisons will in general hold for the states whose total percentages run in smaller figures, and the Prairie States, some of which pay substantial amounts of federal taxes, are almost wholly dependent on others for their wood supply.

Present distribution of lumber cut is, of course, not permanent. As existing stands in southern and western states are cut out, there will be a partial shifting of the industry back to the states that are older in point of lumber production. But a comparison of future needs as indicated by present consumption and population indicates clearly that as a general rule those states which are now deriving from others more than they are shipping out will continue in that status, and those which are sending out more than they receive will continue to do so, if their lands are protected and cared for.

A complete uniformity could, of course, not be expected. Notable exceptions are California and Michigan which, were the national plan for forest fire protection in full effect, would receive in federal assistance more than they pay in, and which are at the same time large "importers" of sawed lumber. What becomes of a large portion of the sawed lumber shipped into these two states raises another of the many complicating questions that always come up in a consideration of the country's forestry problems. California is a large consumer of Oregon and Washington lumber, some of which is remanufactured into containers for fruit that goes to all parts of the country. Likewise Michigan brings in millions of board feet of lumber, only to send it promptly back in the form of furniture and automobiles, and the real consumer and therefore the party at greatest interest is not the Michigan manufacturer or the California fruit grower, but Mr. Common Citizen of Iowa, North Dakota, or elsewhere, who uses Grand Rapids-made furniture and eats California-grown fruit. It will be noted that Michigan's percentage of all forest land is practically the same as its percentage of all retail buying, indicating that the productive capacity of its forest lands might, under good management, approximate the amount of wood which is finally consumed within its borders. But this would not be true of New York, whose percentage of retail buying is 4.5 times its percentage of forest land, nor of Ohio, whose ratio of retail buying to acreage of forest land is more than 10 to 1.

A comparison of columns 2, 4, and 5 shows that of the 29 states which in 1928 derived more than 50 per cent of their sawed lumber from other states, in all but eight, the percentage of total retail buying exceeds the percentage of all forest lands, and it is known that each of these eight states "exports" a heavy percentage of the products derived from its forest lands.

From the standpoint of industrial development and direct use of forests in place, the states in which they are located derive more benefits than do

those to which the forest products are shipped. It is, therefore, proper that the people within these states should advance the larger share of the costs of forest protection.

Present federal law authorizes the Secretary of Agriculture to coöperate with states in the protection of state and privately-owned forest lands in amounts not to exceed what is expended by the states and by the private owners under state supervision. The present federal appropriation is approximately equal to 25 per cent of all moneys expended for forest fire protection. About one-half of the forest land of the country is receiving some form of organized protection and the amounts now being expended are about half of what forestry agencies have calculated as necessary for reasonable protection of all forest lands. Of the other 75 per cent, the states are providing approximately 50 per cent and the private owners 25 per cent.

But this general description of coöperative effort fails to give a correct picture of conditions. Each state is, of course, a political entity and it is what is happening in each that is of importance in shaping forest policies rather than the sum of what is happening in the country as a whole.

Of the moneys budgeted by the states for protection during the current fiscal year, nearly 60 per cent is in the Northeastern, Middle Atlantic, and northern Lake States groups, and of the sum to be advanced by private owners more than 70 per cent will come from owners in the five Northwestern States. The motive back of protection by private owners in the Northwest has been largely the saving of commercial stands, and there are many indications that equal amounts may not be forthcoming from forest land owners, as these stands are cut off. More than 50 per cent of all our privately-owned forest lands is in the States south of the Potomac, Ohio, and Missouri Rivers, including Texas and Oklahoma. It is in these states and those in the far Northwest where most damage is being done from forest fires, and where greater public assistance is seemingly necessary if the Nation's forest lands are to be adequately rehabilitated. Some of the needed funds should be raised within the states and applied directly to their own lands, and, in the writer's judgment, the national interest, as pictured briefly above, warrants a generous participation by the federal government.

PUMPS USED EFFECTIVELY IN CONTROLLING A GROUND FIRE

By KENNETH J. SEIGWORTH

District Forester, Maryland Department of Forestry

An ingenious use of the old-fashioned pitcher pump for furnishing water for fighting a large fire in a dry cedar swamp is here described.

DURING the summer of 1930, the Maryland Department of Forestry was called upon to help stop a ground fire in the famous "Cedar" or "Burned Swamp" on the lower Delaware peninsula after the blaze had covered nearly 7000 acres. Cedar Swamp is an area of some 9000 acres on the head of the Pocomoke River. Most of the swamp lies in Delaware. Until about the year 1700, the area was covered by a dense stand of southern white cedar (*Chamaecyparis thyoides*). As a result of logging and at least two bad fires, the white cedar has largely disappeared. The present timber stand consists of highly valuable red and black gum, red maple, scattered white cedar and an occasional loblolly pine. This timber with the exception of the white cedar is used locally for crate and basket manufacture and fish poles. During ordinary years, water is present on the ground surface to a depth of two feet or more for three or four months. The land is usually damp and "soggy" during the entire year. Under such conditions, much of the dead and fallen vegetation has only partially decayed. This material had accumulated until there was a thick layer of partially decomposed organic matter over most of the swamp. The fallen cedar is in a state of excellent preservation. Many sound logs were found three to four feet below the forest floor.

Although the danger of fire is ordinarily negligible, the swamp has on at least two previous occasions been on fire. Several fires have spread over only a small area until stopped by rain. The belief was current that a ground fire once started in the swamp could not be stopped by human agencies. During the prolonged drought of 1930, the swamp generally was quite dry and much inflammable material was present.

On July 6, lightning struck a tree about five miles north of the Maryland state line. The fire was discovered while quite small and a man was hired by the landowner to extinguish it. It continued to spread during the months of July, August and September. According to local farmers and timbermen, the fire "couldn't be stopped." By early October, the flames had spread to within a half mile of the Maryland line and assistance from the forestry department of that state was requested.

Pumps Introduced

An investigation showed the fire to be spreading slowly, but burning to a depth of as much as four feet over a four mile front. Trenching to the necessary depth was impractical, because of the expense involved and lack of sufficient labor. The suggestion that a back fire be started to check the main surface fire and that pumps be driven to provide water for extinguishing the ground fire was advanced and tried. A

line was brushed along an old slab road, since this seemed the logical front on which to hold the fire. Four ordinary pitcher pumps were driven at intervals of 100 yards as the initial test. The line was back-fired for about one-quarter mile to check the approaching surface fire. In a short time, the flames were eating into the peat accumulation and it was necessary to extinguish the fire along the line.

Buckets and portable Indian-Smith spray pumps were used to transport water from the pumps. Although an enormous amount of water was required to thoroughly soak the ground, it was found that the fire could be completely extinguished. By the end of the first day there were practically no sparks along the first section of the line. The land owners, convinced that the plan was practical, were persuaded to furnish more pumps. In all, twenty-six of them were purchased.

Water was found at depths of from eight to twenty-five feet. The pumps were hand driven by a 50 pound weight, dropped from a pulley attached to a wooden frame. This frame was anchored to surrounding trees by four ropes. Four men were able to drive an average of four flowing pumps a day. Water was not always found on the first attempt, but was usually located by moving the pump from 20 to 30 feet in either direction. The supply of water was not sufficient to supply a power pump or hose line. As one section of the line was made safe, the pumps were pulled and moved ahead. In two weeks, the entire line was in such condition that it could be patrolled by four men.

Ditching was attempted on one occasion when the fire crossed the original line. It was necessary to employ 23 men for a twelve-hour stretch to ditch slightly over one-fourth mile and it was necessary to drive more pumps along the ditch anyway. It was impossible to keep the ditch ahead of the fire and water was again used entirely.

Although detailed cost figures are unavailable, several approximations may be made. The costs were approximately as follows:

Twenty-six pumps complete, including drive points and pipe	$208.00
Labor supplied by Maryland Department of Forestry (actual)	264.00
Probable cost of labor supplied by landowners including patrol	400.00
Total	872.00

As a result of the determined attempt to stop this fire, some 2000 acres of valuable timber was saved. The area over which the fire had spread was practically devastated. Nearly all the trees have fallen, salvage is practically impossible, and much of the soil value has been destroyed. The timber saved, about 1000 acres of which is in each state, has been estimated to be worth $100,000. This demonstration has shown the landowners and the people of the community a method of stopping fires in the swamp where efforts heretofore have been unsuccussful.

Editorial Note.—Professor Woodbridge Metcalf reports another ingenious way to obtain water for fighting fire in a dried swamp in the Lake States. Sticks of dynamite were so placed as to create a large sink when exploded. Although the swamp was dry and burning the water table was high enough to fill the hole rapidly with sufficient water for the fire fighting.

THE CLARKE-McNARY ACT AND FEDERAL RESPONSIBILITY IN CALIFORNIA'S STATE FORESTRY PROGRAM

By J. H. PRICE

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The recent annual meeting of the California Section of the Society was devoted to a discussion of the relations of California's forestry department to various state problems. The resulting papers indicate the apportioning of responsibility between the federal government and the state, and are of interest to those concerned with state functions elsewhere. In the paper here presented, Mr. Price gives an excellent resumé of the background to, and the operation of the coöperative forestry effort between the federal and state government as it exists in California. He reports greatly improved fire protection and cut-over land conditions on private land, and suggests that their continuation makes federal regulation neither necessary nor advisable. Other papers in this series will be found under "Briefer Articles" in this issue. A paper by State Forester Pratt, giving a history of the state forestry department appeared in the April issue.

ANY DISCUSSION of the field of the federal government in the forest program in California would be incomplete without at least a brief review of the events that have brought about the present relationships. The creation of the national forests from the public domain and the provisions for their protection and use, was the first and most important step taken by the federal government, and nothing more need be said of this. The next most noteworthy event prior to the decade just ending was the enactment of the Weeks Law in 1911. This Act definitely established two principles: first, that of the purchase of private lands for incorporation into the national forests, and second, that of financial assistance to the states in fire control. It is in the second provision of the Act that we are most interested today since it marked the beginning of direct financial coöperation by the federal government in the management of state and private forest properties. In principle, the passage of this Act was based upon the benefit to accrue to the nation in conserving the navigability of streams, this being long accepted as a federal obligation, and the field of coöperative effort was limited strictly to areas having such a function.

As early as 1912, an effort was made to have California qualify for an allotment under the Weeks Law. Despite the fact that there had been a State Board of Forestry and a State Forester for many years, there were no state funds set up specifically for forest protection. This is not to say that there was no protection being afforded to private lands. In 1912, there is record that certain private owners were spending considerable sums for this purpose, and undoubtedly there was much additional effort not of record. Also, many of the counties had more or less effective fire control organizations, and the State Forester was doing what he could with a small-staff organization. It was not until 1919, however, that forest protection was concretely recognized in the state appropriations. At that time, $25,000

was budgeted for the two year period following July 1, 1919, and on the basis of this new appropriation, California obtained a Weeks Law allotment of $3500. This was increased slightly in 1920, and in 1921 due to increased state appropriations, the allotment became somewhat over $20,000, at which sum it remained for several years. Small as these figures seem to us now, they represented a beginning, an important one as events since that time have demonstrated.

About the time of this initial coöperative effort in California, the entire national forestry situation was being subjected to much scrutiny. The heavy demand for forest products of the post-war period focused attention again on the threat of a timber shortage. The advent of high-powered logging machinery had, in certain regions among which was California, brought a new complication. Not only was cutting on private land conducted so as to take trees of small diameter, due to the high prices of lumber at the time, but also, the new logging methods were destroying much of the material that would have otherwise remained on the ground in the form of poles and reproduction.

As in the past, there were two classes of thought as to what should be done, the only agreement being on the importance of forest protection and the desirability of the extension of public ownership. One school urged federal control of timber resources and definite cutting regulation. The opposed school recommended educative and coöperative attack on the problem, leaving to the states any regulation that might eventually prove necessary. Congress took action in the form of Senate Resolution 311 asking for a report on the entire forest situation. This resulted in the timber depletion studies published by the Forest Service and often referred to as the Capper report.

It is not here necessary to go into arguments for and against federal regulation. It is sufficient to say that the Forest Service as an organization recommended the coöperative plan of attack—a plan, however, that was not without some regulatory features. Federal legislation was recommended:

1. To extend coöperation with the states in fire control and in forest renewal.

2. To stimulate the enlargement of the national forests by purchase and exchange.

3. To re-forest denuded federal lands.

4. To study forest taxation and insurance.

5. To make a survey of the forest resources of the nation.

6. To enlarge the research program.

Of the foregoing six measures, federal coöperation in fire control was held the most important and received the most emphasis. It was in connection with this measure, too, that it was proposed to incorporate indirect regulatory features. It was recommended that the Secretary of Agriculture should be authorized, in making such fire control expenditures, to require reasonable standards in the disposal of slashings, the protection of timber and cut-over lands from fire, and the enforcement of equitable requirements in cutting to prevent forest devastation, and to withhold coöperation in whole or in part from states which did not comply with these standards.

For the states, there was recommended legislation covering:

1. Effective fire control for all forest properties.

2. Provision for proper slash disposal and cutting methods.

3. State assistance to owners in planting.

4. Formation of state and municipal forests.

5. Equitable forest tax laws.

The publication of these recommendations was followed by educative and preparatory studies and publications among which were Colonel Greeley's "Timber: Mine, or Crop," and the series of bulletins on desirable cutting practice on private land commonly known as the "Minimum Requirements" studies. Public hearings were held by Congressional Committees and legislation was drafted and considered by Congress. Finally, in 1924, the Clarke-McNary law was enacted. This law provided for:

1. Assistance to the states in studying their fire control problems.

2. Coöperative expenditures in financing the fire control organization, omitting, however, the requirements originally recommended in reference to state control of cutting methods.

3. Coöperation in distribution of forest planting stock, limiting this to windbreaks and woodlot plantings on farms.

4. Coöperation in forest extension, particularly in woodlot and windbreak projects.

5. Extension of the national forest areas through purchase and gift.

6. A study of forest taxation.

The more or less coincident program in California resulted in the compulsory fire patrol law, a more effective code of fire prevention laws and the law exempting young forest growth from taxation.

The authorization carried by Section 2 of the Clarke-McNary Act, which is the section having to do with coöperative fire control, and the one of most importance to California, was $2,500,000 annually, under which the initial appropriation was $700,000. Of this amount, California received an allotment of about $30,000. The appropriations and allotments have increased from time to time until for the present fiscal year, the California allotment is $147,000. Since 1925, the state effort has increased at a similar rate. The state appropriations are now about $300,000 annually. Coöperative funds made available by the counties and by the private timber owners amount now to about $250,000 annually. This makes a total fire control budget of about $700,000. It does not include large expenditures for grass, grain, logging area, and rural protection, which activities are not covered under the Clarke-McNary law. It does include, however, expenditures on areas of recognized watershed value, for in 1925, the Clarke-McNary Act was amended to provide Federal coöperation on such areas as well as on timber lands.

The omission from the Clarke-McNary program of the proposed indirect regulatory feature in respect to cutting practice was due to several reasons: first, there was undoubtedly the matter of expediency; second, there was a general agreement that effective fire control was the phase of the forest problem of the most immediate importance. It

was said that protection from fire constituted 75 per cent or more of the forest problem in the West. At any rate, forest protection was undoubtedly the largest problem to solve in order to perpetuate the forests and any legislation that would give an impetus to its solution was considered well worth while. Third, there was a tacit agreement on the part of the lumber industry that upon receiving aid in fire control and taxation, it would make every effort within reasonable economic limits to leave cut-over lands in productive condition.

How far have we progressed under the coöperative plan? I think that all of you will agree with me that there has been a sincere and united effort toward effective fire control. As we have seen, federal, state and private expenditures have increased many fold in the last ten years. Our efforts may not have been as successful as could be desired, but I think we have a right to feel at least some encouragement. One noteworthy attainment has been the decrease in burned area resulting from operating fires during the last five years. Another has been the establishment of protection organizations throughout nearly all of the fire-hazard areas of the state, working under what is to all practical purposes unified control. It is inconceivable that these organizations, inadequate as they may be in many respects, are not having the effect of reducing damage from fire far below what it otherwise would be. Lastly, and perhaps most important of all, there has been very definite progress in developing a public appreciation of forest values and the part that fire control plays in their perservation.

Progress in forest protection, however, is only one measuring stick. We must also ask ourselves how far we have progressed in leaving cut-over lands in such condition that, if protection is made effective, forest crops can be produced within a reasonable time. Several changes have taken place during the last few years that have altered somewhat the economic phases of cutting in California. Of first importance has been the abandonment in a large part of the state of donkey-engine logging in favor of tractors which, from their very nature, are less destructive to young forest growth. Second, there has been such a reduction in lumber prices that well informed operators no longer believe it economical to log trees of small diameter and in fact some leave all trees of certain species. These two factors taken together have naturally resulted in leaving the areas cut over during the last few years in better shape than those logged during the first half of the decade. This change in the condition of the cut-over areas, coupled with the very effective fire control that the operators have furnished, are encouraging. No one will argue that this alone means that good forest practice has necessarily been found feasible and is being practiced by the industry. Leaving the inferior species uncut in the mixed stands of the Sierra Nevada region as is now quite generally done, is extremely poor silvicultural practice on most areas, but in general, logging practice *has improved* and our cut-over areas show the effects of this and of better protection. That the improvements in both logging and fire control have resulted largely from certain economic considerations is certainly not to

be regretted. For that very reason, both are on a firmer foundation than if they had been brought about merely through compliance with the desires of the forestry profession. My concern is along quite another line. When economic conditions in the industry change, as inevitably they will, there may be a recurrence of land skimming without that due regard for future crops which then, of all times, should be economically feasible. Then will come the real test of the economic foresight of the lumber industry. Even this concern is somewhat lightened by other considerations which I shall attempt to develop later.

Judging by the progress to date under the coöperative program, I see no immediate necessity for change in the general plan. The federal government should see that its support in fire control grows in pace with that given by the state and private owners. It should continue the present policy of rounding our national forest units by exchange. Acquisition by purchase should be extended to California to hasten this process, and the establishment of a new national forest unit in the redwood region is much to be desired. The limitations now existing on the coöperative distribution of forest planting stock should be removed, so that the planting projects on watershed and timber lands may be authorized when they become desirable. The present program of research should of course be continued. As far as federal regulation of cutting practice is concerned, I do not think it necessary or advisable in California, certainly not at the present time, and I trust not in the future.

One important factor of forest protection that apparently did not enter largely into the discussion of the program in the early part of the decade but that has become an important factor in gaining public support is that having to do with those forest values formerly considered of a secondary nature. Watershed and recreation values and wild life protection are no longer secondary, at least in most portions of California. They have become of equal importance with the value of the forests as sources of wood, in fact, in many cases, wood production is becoming secondary. It is around these values that public interest has, in the main, taken shape. This is quite natural, since water is the resource governing the development of much of the state and since forest recreation is becoming more essential with the urban trend of population. The people of California have never experienced a wood shortage but they have perceived the water tables dropping, have seen recreational areas blackened by fire, and have felt the economic ills that both these occurrences bring with them. It is through these experiences that public opinion in reference to the management of forest lands is slowly but surely taking form. It is the recognition of these particular forest values that is coming ahead of any appreciation of a real or fancied wood shortage, and that is going to lead to adequate protection of forest land, whether public or private, and whether against fire or against the axe. If permanent forest management of private lands can be worked out voluntarily so that it is compatible with the public interests involved, all well and good. If

not, there will necessarily be some sort of state legislative action to preserve not only the public values but also to insure that private interests are dealt with fairly.

It is for these reasons that I think federal regulation is unnecessary in California. I think that the state can work out its own salvation, and in so doing, will protect the national interest. I trust that we, lumbermen and foresters, can produce and exercise the necessary technical skill and economic foresight to handle our forest properties with due consideration for all interests. If private and public interests cannot be reconciled voluntarily, then we, lumbermen and foresters, but above all—citizens, shall need these same qualities, coupled with no small amount of skill in statecraft, to develop some other plan that will as fully as possible protect the equities of all concerned.

FORESTRY FOR THE CENTRAL CORN-BELT FARMER

By J. A. LARSEN

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Iowa and other Central states have extensive areas of land too poor for farming but well suited to growing trees. The author believes that if these states, which have to import nearly all of their wood needs, would afforest their waste lands they would increase local values and at the same time develop a reliable source of forest products for local requirements. What the author says of this region points to the urgent need of intensive land utilization surveys in each state.

THE CENTRAL corn-belt farming states import over ninety per cent of the lumber needed in their construction and wood-working industries. Most foresters will reply, "There is nothing remarkable in this. These states are not able to produce enough lumber for their own needs, anyway. Their business is to raise corn instead of wood; they are satisfied to continue to sell agricultural crops and import their lumber."

But are they satisfied? Can they afford to ignore or exclude forestry? Have they no land suitable for trees? The remarkable thing is that if these farming states would put all of their waste land into forests the South and West would have to market their manufactured lumber elsewhere. Yet, there is no need for immediate apprehension on that score, for as long as high grade virgin timber is available they will continue to buy it rather than to raise it themselves.

But mere wood production is after all only a small part of forestry. These corn belt states must have forestry in the broadest sense. They need trees not only on their idle lands to put them to work, but also to halt erosion on certain areas and to heal the ever-deepening gullies caused by past mismanagement; to maintain lakes and streams in their natural condition so as to maintain the water table beneath their precious farm land and to prevent floods; to harbor migratory and insectivorous birds and to preserve animal life, hunting grounds and recreation areas. These various phases will be examined more closely, one by one.

Let us consider one of the states, Iowa, the hub of the corn-belt, blessed with a very high percentage of highly developed farm land.

Iowa has 214,000 farms, each requiring an average of 2,000 board feet of lumber and about 80 fence posts each year costing about $20,000,000. The 9,750 miles of railroad in operation require nearly 3,000,000 ties annually, costing as many dollars. All primary and secondary roads, not to mention the railroads, have well developed telephone and telegraph systems demanding poles in the hundreds of thousands, the expenditures for which run into the millions of dollars each year. The wood-using industries require about $25,000,000 worth of high-grade material, and the wood consumed comprises in round numbers 500,000 cords costing over three million dollars. This

makes the total expenditure for the wood requirements of the state each year about $58,000,000.

Eventually, most of this may be produced within the state; at least the round material and lower-grade products, for there is an abundance of land not now in corn or other crops and not needed for pasture, which could and should be devoted to the growing of trees. Such land is not $200- or $300-per-acre land. It is not rich, black, level, prairie soil, but eroded farm land, over-flow areas along the streams, bluff land and islands along the Mississippi and Missouri rivers, lake shores, stony and gravelly patches formerly glaciated; coal lands and parcels cut off by ditches or wet places. Estimates place the total area of such lands in Iowa between 2,000,000 and 2,500,000 acres. All of the other central farming states list such areas in the millions of acres. One county in the eastern part of the state contains no less than 72,000 acres of non-arable land and another, 55,720 acres. This is listed as wasteland, and it lies in the very heart of the corn-belt.

One of the southern Iowa counties has two townships out of the sixteen so badly eroded and so infested with weed grasses that nothing but trees will make a crop. They are utterly unsuitable for grazing. In Indiana are several counties of worn out and badly eroding land so poor that one may travel for miles without seeing a single farm. This is facetiously spoken of as the Great Indiana Desert. There is but one farmer in one township, whose only cash income is derived from driving his own children to and from school, and they are the only children in that school. Afforestation would put the waste lands to work, preventing their further destruction, and would provide income-bearing capital.

Those who do not believe that an acute forest problem exists in the central farming states have but to turn to the Sherman report on the *Protection of the Mississippi Watersheds and their Influence on Flood Prevention,* 1927, in which it is stated that Iowa has 17,457 square miles of land in the critical column, Missouri, 15,844, and Illinois, 12,598 square miles. Sherman states: "The most difficult part of the forest problem in the Mississippi drainage is that having to do with 115,000 square miles of the forest land in farms and in regions primarily agricultural. The problem is exceedingly complex, the land is within the absolute control of millions of individual independent farm owners who are usually unaware that other interests may be injured if the hillside forests are over-grazed, burned or cleared off; * * * * * and the fact of excessive soil erosion from farms is as conspicuous in every report on a drainage unit including considerable quantities of farm lands that it becomes an outstanding finding of this study".

To trained foresters there is naturally no need to emphasize the relation of forests to streamflow, run-off and water tables underlying arable land. In these central states the last twenty-five years have witnessed untold stream straightening and lake drainage projects most of which have been followed by baneful consequences. It is not difficult to find farmers who admit that their wells must be sunk deeper from year to year following extensive tiling and stream-

straightening projects. For stream straightening hastens the exit of water from the territory, deepens the main channel as well as the lateral erosion gullies, causes intermittent water flow disastrous to fish and animal life and lowers the water table under farm land, while the detritus carried down-river by the straightened streams clogs many of the lower channels, causing the water to rise to abnormally high levels.

Lake drainage has also become an obsession with many people in the central agricultural states. Most of these completed projects have not justified themselves, mainly because the land is "dead". Having been inundated for ages, it is either strongly chemical or lacking proper aeration and bacterial life. These drained lake beds are useless for pasture and in most cases remain unsightly mud flats. The drainage furthermore lowers the water table and destroys feeding and breeding grounds for water animals, migratory and insectivorous birds. Such natural lakes when left undrained, remain important beauty spots and recreational areas and become valuable for hunting grounds because they invariably teem with animal life. They are invaluable as camp sites for Boy Scouts, Girl Reserves and outing resorts for people who have neither the time nor the means to do their vacationing in the National Parks. Iowa has no less than ninety lakes.

In these relatively flat and expansive windswept states where the biting blizzards descend from the north and where blighting hot winds sweep in from the southwest in summer, man, stock and crops profit greatly from well-planted shelterbelts—evergreen trees planted fairly close to the dwellings and farm yards for winter protection, and from windbreaks of hardwood species along roads and fences to shield the crops from summer drought and excessive evaporation. In actual cash it is considered that a good shelterbelt is worth five dollars more per head per year, measured in increased beef production.

As the conditions now are, thousands of farmers need these windbreaks and shelterbelts. The early settlers were fully aware of it and planted cottonwoods, willow, boxelder, and soft maple, for these trees were readily available at the time of first settlement when evergreens were not obtainable. But the early shelterbelts are now old and ragged and in need of replacement. In the northern and western parts of the corn-belt states, skirting the periphery of the prairies of the Great Plains on the western edge of natural tree-growth, the need for shelterbelts or windbreaks is acute, and there, all such plantations are indispensable. They are then usually in the form of a combination woodlot and shelterbelt—the central rows, of hardwoods, devoted to fence posts and fuel production, and the outer rows, usually of conifers, more widely spaced, for wind obstruction. When it is remembered that one of these central states has 214,000 farms and that each farm needs a woodlot and shelterbelt or a combination of these, the number of trees needed mounts into huge figures.

What shall be said for the trees suitable for this region? We find here the meeting ground of most eastern, northern, and central hardwoods,—black walnut and hard maple, tulip tree and bass-

wood, red oak and the most valuable hickories. There is not an evergreen tree in the northern states which will not thrive here and grow faster than in its native haunts. White pine, northern white cedar, Norway pine, and jack pine rub elbows with luxuriant western yellow pine, Black Hills spruce, Douglas fir and concolor fir. Even Asiatic conifers show considerable promise.

Much need not be said about the climate. A growing season of from 180 to 200 days and a well-distributed precipitation of forty inches, makes the climate suitable for hardwoods and evergreens alike. The long growing season, the favorable temperature, and the absence of prolonged droughts are factors contributing greatly toward rapid growth of timber.

The present natural forest area in the state of Iowa is close to 1,800,000 acres. This is made up entirely of "native woodlot", by which it is distinguished from planted woodlots. These natural areas have been heavily culled of their most valuable species, white oak, black walnut, white ash, hickory, but the less desirable trees,—soft maple, elm, sycamore, honey locust, and others—now predominate. Besides, practically all of this natural forest land is heavily grazed by cattle so that restocking is conspicuous for its total absence. Forestry must come to the rescue of these neglected woods by excluding stock, harvesting defective trees and natural or artificial reforestation according to local circumstances.

But the greatest promise for forestry in the corn-belt resides in the planting of new woodlots, and, as previously stated, necessity and opportunity invite the planter of trees. There are many examples of unusually rapid growth from plantations. Carolina cottonwood, planted on bottomlands subject to overflow, has attained a height of 75 feet and a diameter of 16 inches in 16 years. When creosoted by the open-tank method on the farm this species can be used for fence posts and will extend their service to twenty years. Lumber has already been sawn in several locations from planted cottonwood, black walnut, soft maple and white pine. Black walnut is without doubt the most valuable timber tree in the United States. A truck load of such logs can be sold anywhere in the state and at any time.

Given the climate, fertile soil, and valuable species it will readily be understood that these central corn-belt states will be in a position to produce a well-nigh infinite variety of woody products. The farmer needs the trees and he must be convinced of it. It is with him and trees as it is with a man who builds a house; he could rent much cheaper but still he builds one. There are many things in life which we need and cannot do without, or which do not pay in cold cash or compound interest, yet upon which we continue to spend money. The farmer may not think that money laid out in planting trees on his farm will bring in satisfactory returns, but he cannot afford to keep his money in the bank and let his farm go to ruin.

The question naturally arises: how may we best sell forestry to the farmer? Interest returns on money spent on forest planting will be forthcoming as well here as anywhere, but to most farmers this is not an alluring proposition. We must sell forestry first of all by preach-

ing and showing all of the other benefits, which the farmer does not or may not appreciate, and which have been enumerated above. County agents should, above all, be strongly forestry-minded men, forcible, and able to put forestry over to the land owner. Every growing boy and girl in the grades, high schools and colleges should be exposed to a vigorous and contagious forestry educational campaign, by the installation of farm forestry courses, essay and prize contests in the various outdoor activities of which forestry is a vital part. There must be no letting up of aggressive extension programs, backed up by energetic leaders, and there must be more and more demonstration areas and a continual use of the press. State nurseries should be established wherever they are lacking and the output of planting stock greatly increased. Grazing and fire must be eliminated from the woods. Taxation should be adjusted in all the states in order to exempt young timber or relieve it from too heavy a burden.

It may be readily understood that when real forestry comes to the corn-belt states, it will be of an intensive kind. The holdings will be relatively small and therefore more closely supervised, and they will be better administered. Cleanings, thinnings and prunings will be the accepted practice; rotations will be shorter than in the mountainous areas because of more rapid growth and closer utilization because of demands for much small timber as posts, ties, mining props, fuelwood, etc.

The plantations will be spaced more rigorously in accordance with the soil, product, rate of growth and management than is possible on large and less accessible tracts, and there will come about a very close allocation of the species in conformity to soil, local needs and markets. This intensive practice will be favored by nearness to market or railroads, and by negligible outlay for permanent logging improvements.

That forestry, and a very intensive kind of forestry, will come to these central corn-belt farms, no one with a clear understanding of their intrinsic needs and possibilities can doubt.

A METHOD OF ACCURATE HEIGHT MEASUREMENT FOR FOREST TREES

By JOSEPH G. FALCONER

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Before research studies of tree growth can be considered conclusive, the accuracy of measurements must be demonstrated. One measurement of a standing tree always difficult to obtain is height. The author describes a method for obtaining this dimension which he found correct within one per cent.

WHILE investigating forest vegetation types during the past season as a member of the Research Division of the Ontario Forest Service, the writer had occasion to measure the heights of white pine (*Pinus strobus*) trees on sample plots. An Abney level, equipped with an arc graduated in percentage intervals was used to take height readings from two or more different points on the ground. It was not uncommon to find a height variation of from 2 to 10 feet for the same tree when the calculations were made from readings taken from different points. This inconsistency led to the more careful measurements on a number of standing trees, the distances being measured to one-tenth of a foot and corrected for slope. (Table 3.)

The trees were selected on the following basis:

1. Trees with good leaders, clearly visible.
2. Straight trees.
3. Trees that appeared vertical.

From two to five readings were taken from different points and the calculated heights were averaged; the trees were then felled and measured. The tabulated measurements are recorded in Table 1.

TABLE 1

RECORD OF MEASUREMENTS AND ERRORS

Height measurement of standing trees	Measured length of the same tree when felled	Error
Feet	*Feet*	*Feet*
105	107.9	—2.9
97	102.0	—5.0
96	103.5	—7.5
93	98.7	—5.7
109	112.2	—3.2
109	112.0	—3.0

(Average error per tree is 4.55 feet.)

In the Table 1 data, the calculated tree heights were in each case, less than the actual measured tree length. The reason for this error being constantly negative (as was found later) was that an observation position was avoided if the tree appeared to lean toward the observer at that position.

In reviewing permanent sample plot data the writer also found wide discrepancies and variations in a large percentage of the tabulated tree heights. In fact, some heights taken at five-year intervals appeared to have decreased, others to have increased beyond proportion, while very few trees from the records at hand appeared to have a normal increase in height growth. Krauch (5) reports, that new measurements of tree heights on sample plots in many instances were lower than those secured five years previously. Accurate heights

are less essential in rough cruising than in research. It is quite evident that if forest research, based upon recorded data, is to be conclusive the basis must be accurate within reasonable limits, which may be described by statistics. Furthermore, a more accurate determination of height is necessary than that furnished by the method usually employed if tree heights are to be used as an index of site quality, and if different sites are to be separated on a basis of 10-foot height intervals—perhaps even 5 feet (2).

Simmons (7) states that the measurement of standing trees by means of instruments is based upon one of two principles, either:

a. the geometrical properties of similar triangles, or,

b. the trigonometrical properties of angles, between which there is really no essential difference, since in either case a measured distance is used in the calculation. Because of this fact an analysis of errors in the measurements of tree heights has a general application.

In addition to the general errors in measuring the height of vertical trees, which is very effectively treated by Graves (3) and Chapman (1), the following should be considered:

The observer may be either too near or too remote from the tree. An error of one degree in reading the height-measurement instrument, causes a greater percentage of error in the calculated tree height as compared to the true height, when the angle subtended at the observer by the intersection of the lines from the top and the base of the tree is either greater or less than 45 degrees. For example, if the observer is constantly reading one degree too low, then, if the tree is 100 feet high and the observer is 100 feet from the tree, he would read an angle of 44° instead of 45°. From this reading the calculated tree height is 100 x tangent 44° = 96.57 feet, or an error of 3.43 per cent. If the observer stands at a distance of 50 feet from the tree, he would read an angle of 62° 27′ instead of 63° 27′. The calculated tree height from this reading is 50 x tangent 62° 27′ = 95.85 feet, or an error of 4.15 per cent. If the observer stands at a distance of 200 feet from the tree he would read an angle of 25° 30′ instead of 26° 30′. The calculated tree height from this reading is 200 x tangent 25° 30′ = 95.61 feet or an error of 4.39 per cent.

In the case of a leaning tree additional errors may arise:

1. When the position of the observer is parallel to the lean of the tree and the tree leans:

   a. Away from the observer.

   b. Toward the observer.

2. When the observer is in any other position than parallel to the lean of the tree.

Chapman (5, Pa. 245) and Graves (3, Pa. 149) state that a leaning tree should be measured from a position at right angles to the vertical plane of the tree, the objective being to arrive at an accurately measured distance.

Krauch (5) states that readings taken from different points are not the same for the reason that the horizontal distances are different, when the top of the tree is considered. The condition which is most apt to cause a discrepancy between two sets of readings is the variance of the tree from a vertical position. This

condition is not readily perceived without the use of a plumb line, but the fact is that there are very few trees which stand absolutely vertical. In general, I found that the error in measuring the height of leaning trees is directly dependent upon the measured distance used in the calculation of the tree height. It is difficult for the naked eye to detect a lean of three feet or less on a tree in the 100-foot height class. Furthermore, over one half of the trees measured for height, after using the principle outlined below were found to have a lean of three feet or more from the vertical plane.

The incorrect location or choice of the point to which the measurement for distance is taken is the only common and continued source of error in measuring the height of leaning trees. The error is due, not to the actual chainage of the distance, but in the location of the point to which the distance is measured. The distance can be accurately measured only when the point is located on the ground vertically below the tip of the tree. This point lies on the intersection line of two vertical planes at right angles to one another which pass through the tip of the tree.

In actual field practice, a plumb bob, an increment borer or some other convenient heavy object that will hang vertically if suspended by a string may be used for the location of the desired intersection point. Surveying transits[1] may be used if absolute accuracy is desired, but are usually not practical for ordinary field work. The following field method is recommended: to obtain the vertical height of a tree:

a. Use two plumb lines from 4 to 6 foot long. Have one man handle each plumb line and a third party locate the desired point.

b. Govern the location of the two observers with the plumb lines as follows:

1. One observer parallel to the lean of the tree, with the tree leaning toward him and the other at right angles to the lean of the tree. The angle subtended by the two observers below the tip of the tree should be as near as practical to 90 degrees, because variation either way from 90 degrees will decrease the accuracy with which the intersection point may be located.

2. Maintain good visibility for each observer to the tip and the base of the tree—preferably a point about 6 feet above the ground level.

c. Have each observer, sight or line in the plumb line string with the tip of the tree. They now direct the ground location of the intersection point of the vertical planes that pass through the tip of the tree and plumb lines.

This point is vertically below the tip of the tree. Irrespective of where the readings are taken, if this be the point to which the horizontal distance is measured or calculated, the height of the tree will be the same to all observers, within the limits of personal accuracy and the precision of the instrument in use.

This method was checked by measuring the trees after they were felled and the results in Table 2 were obtained:

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[1]Carefully adjusted transits, if located according to the same conditions as stated for observers in this paper, may be used when very accurate results are desired, for the location of the intersection points of the desired vertical planes. The transit telescopes may be used to locate the vertical planes, by simply revolving these on their horizontal axis.

TABLE 2

RECORD OF MEASUREMENTS AND ERRORS ACCORDING TO NEW METHOD

Height measurement of standing trees	Measured length of the same tree when felled	Error
Feet	*Feet*	*Feet*
105.00	105.50	—0.5
99.30	97.70	+1.7
94.50	93.50	+1.0
105.00	105.00	0.0
89.40	89.50	—0.1

(Average error per tree is 0.64 feet.)

The following suggestions may be useful in field work:

The time required for the procedure is minimized when the angular readings are taken and the distances measured from the same point and at the same time as the location of the intersection point of the planes.

When only two men are available, one plane can be temporarily located by using tall stakes, especially when the forest cover is dense. The intersection point of the second plane with the one temporarily located either is on the line between the two stakes or on an extension of this line.

The length of time may be shortened, when the timber is devoid of underbrush, by placing stakes about 10 feet long, longitudinally on the ground in the horizontal projection of the vertical planes at the base of the tree (6). This method is not recommended unless the ground is free from underbrush and other obstructions that interfere with the accurate location of the stakes.

The top of a stake equal in height to that of the observer's eye has a decided advantage, as compared to the base of the tree if it be used as a sighting point (4). (This additional height must be added when calculating the tree height.) Such a point is more readily visible than the base of a tree and is usually more definite; also, the direct reading is the degree or percentage inclination from the observer to the point in question. The slope correction can be made directly from this reading by the use of Tracy (8) if the reading is taken in degrees; if the reading is taken in per cent, Table 3 is compiled from natural trigonometrical functions of angles and is very convenient because it reduces inclined measured distances, as measured in 100-foot units, to a horizontal distance for each percentage interval, from one to thirty-six inclusive. It may be used in conjunction, either with a slide-rule, or with a calculating machine.

In permanent sample plot work, or where the total length of the tree is desired, it is advisable to record the distance from the center of the tree base to the intersection point of the planes used for the horizontal measurement. It is common practice to neglect a lean of less than 5 per cent, because the correction is practically negligible—being only 0.125 feet (Table 3) per 100-foot inclined distance. If it is desirable to correct the calculated vertical height by conversion to the total length then Table 3 is convenient, *i. e.*, if a tree with a vertical height of 90 feet has a lean of 9 feet, this is equivalent to a 10-per-cent lean. The total length is then 90 divided by 99.503 (see Table 3—opposite 10 per cent) equals 90.449 feet.

TABLE 3

REDUCTION OF INCLINED DISTANCES TO THE HORIZONTAL

Inclined distance=100 feet

Slope reading Per cent gradient	Correction	Horizontal distance
1	0.005	99.995
2	0.011	99.989
3	0.045	99.955
4	0.081	99.919
5	0.125	99.875
6	0.179	99.821
7	0.244	99.756
8	0.318	99.682
9	0.403	99.597
10	0.497	99.503
11	0.601	99.399
12	0.714	99.286
13	0.835	99.165
14	0.965	99.035
15	1.107	98.893
16	1,256	98.744
17	1,415	98,585
18	1,582	98.418
19	1,757	98.243
20	1,941	98.059
21	2.135	97.865
22	2,336	97.664
23	2.544	07.456
24	2.760	97.240
25	2.986	97.014
26	3.217	96.783
27	3.456	96.544
28	3.703	96.297
29	3.597	96.043
30	4.218	95.782
31	4.484	95.516
32	4.757	95.243
33	5.037	94.963
34	5.322	94.678
35	5.614	94.386
36	5.912	94.088

CONCLUSIONS

In actual field practice the method advocated above can be relied upon to give results that average within one per cent of the true height of the tree, in the case of trees within the 100-foot height class.

The average error per tree, by the use of this method was reduced to approximately one-eighth of the error found by using the method generally employed.

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THE STOCKED-QUADRAT METHOD OF SAMPLING REPRODUCTION STANDS

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The launching of the nation-wide forest survey directs considerable interest to rapid and accurate methods of sampling reproduction stands. The method here described is based on a small unit of such size as will be fully stocked by one seedling or tree at maturity. While the method has been in use nearly a decade, the fundamental reasoning with regard to the determination of the size of the unit has not been given expression heretofore.

CONSIDERABLE interest has been shown among foresters of late regarding the methods of sampling reproduction stands to determine the degree of stocking or proportion of total area being fully utilized by the reproduction. This subject has been under discussion for five years or more in the Northern Rocky Mountain region in connection with the examination of reproduction on national forest cuttings, and on private cut-over lands which are being considered for purchase by the government. More recently it has arisen in connection with the nation-wide forest survey, one phase of which entails the classification of cut-over lands and burns according to degree of stocking; for example, as devastated, poorly; partially- and well-stocked. Because of the nation-wide scope of this work, it is believed that the methods used in the Northern Rocky Mountain region for sampling reproduction stands and the reasoning on which these methods are based might be of interest to the profession at large.

The system used, the stocked-quadrat method,[1] is based on the assumption that if a given area is divided into squares of such a size that one established seedling or tree per square will fully stock the square at maturity, then the percentage of units so stocked, regardless of total number of seedlings per acre, indicates the proportion of land being utilized by tree growth. The method was first employed in this region as early as 1921 in a transect study of cut-over areas conducted by W. C. Lowdermilk.[2] Lowdermilk discovered early in this work that the extent of restocking is more influenced by distribution of seedlings than by their number. This is particularly true in the dense stands characteristic of the western white pine type in which the number of seedlings per acre might appear to be very satisfactory and yet a considerable part of the area might be entirely bare due to uneven and patchy distribution of the seedlings and residual trees present. Conditions on each cut-over area, therefore, were expressed not in total number of seedlings per acre, but in percentage of mil-acres stocked, the mil-

[1]A good descriptive term for the method recently coined by T. T. Munger.

[2]A Unit of Area as a Unit of Restocking. W. C. Lowdermilk. Applied Forestry Notes, No. 17, U. S. Forest Service, Missoula, Mont.

acre or 6.6-foot square having been the field unit decided upon at this time.

This procedure was followed in later years and in 1926, when the Regional Forester started an intensive inventory of growth conditions on national forest cut-over areas in Montana and northern Idaho, total number of seedlings was ignored entirely and the percentage of mil-acre stocked with at least one seedling or residual tree was taken as the criterion by which the success or failure of the cutting was judged. In this work a series of strips were run across the cut-over area at definite intervals, each strip consisting of a contiguous series of 6.6-foot or mil-acre squares. The estimator simply recorded each square as stocked or non-stocked and in expressing reproduction conditions on a given area merely stated the percentage of mil acres occupied by seedling reproduction or residual trees.

When this work was started there was considerable discussion about the size of unit to be employed. The mil-acre was finally adopted because of its convenience in field use and office compilations, but it was regarded by many foresters as too small a unit to require one seedling per square or a minimum of 1000 seedlings per acre for perfect stocking and the Regional Forester's office decided that any area with forty per cent or more of the mil-acres stocked would be considered in excellent condition. The writer, working at this time on reproduction studies conducted by the Northern Rocky Mountain Experiment Station, felt that either this percentage figure was too low to set as a measure of good silvicultural practice, as reflected by reproduction conditions after logging, or that the mil-acre unit on which it was based gave a distorted picture of timber sale conditions. Certainly any silvicultural method that might leave a maximum of 60 per cent of the area blank could not be considered satisfactory. On the other hand, if forty per cent or more of units as small as mil-acres were occupied by seedlings, it could be reasonably contended that the seedlings would in time encroach on the surrounding blank areas to a very material extent, and thus produce at maturity a satisfactory degree of stocking. This thought pointed to the desirability of selecting a unit of larger size. Starting with the premise that the size of the unit adopted must be such that one established seedling per square would give full yields at maturity the line of reasoning used was somewhat as follows: Theoretically, the widest distribution under which it would be possible to obtain complete stocking at maturity would be a distribution in which each tree was provided throughout life, i.e., to rotation age, with the maximum growing space needed. This condition does not occur, of course, under actual forest conditions, but it is approximated in the growth of dominant and perhaps codominant trees that have been throughout their life least affected by the competition of their neighbors. The best measure we have, therefore, of the maximum space that can be effectively utilized by forest trees is illustrated by the space utilized by the trees of the dominant stand. For average good sites (Site Index 60) in the western white pine type, the yield tables show 153 such trees per acre (including both

ominants and codominants) at the approximate rotation age of 120 years. his number embodies practically all ees 13 inches in diameter and up. But ese individuals growing at about the aximum rate for trees under forest onditions and practically affording a losed canopy at rotation age still fail fully utilize the site, for they contain nly 84 per cent of the total board-foot olume which it is possible to produce t this age-site in fully stocked stands. his indicates that more trees—or ather closer spacing—are necessary to each full board-foot yields at rotation ge. The western white pine tables ow that when such full yields are eached there are about 290 trees per cre 7 inches in diameter and up. Each f these trees occupies about 150 square eet or a 12.5-foot square. It seems gical to reason, therefore, that if ands of western white pine reproduction contain at least one established eedling, sapling or pole per 12- or 13-ot square, it would be quite possible r this stand to produce full board-foot olumes at rotation age. Seedlings at ore frequent intervals might be derable for quality production and to rotect more thoroughly the site from eterioration by exposure, but they ould not be absolutely necessary to assure full stocking at rotation age. On e other hand, it seems quite possible that seedlings distributed at greater intervals will never be able to utilize the entire area and hence produce full yields. Accordingly, the four-mil-acre or 13.2-foot square was adopted as a good convenient field unit with which to measure the degree of stocking in the western white pine type. This unit is now being employed in cut-over area studies and land-exchange work throughout Region 1 of the Forest Service.

The four-mil-acre unit is directly applicable, of course, only on average sites throughout the western white pine type. But when yield tables are available, the same method of reasoning can be utilized in working out the proper size of unit for other types and sites. For example, Behre's yield tables for western yellow pine show that on an approximately average site (Site Index 80) there are about 180 trees per acre at rotation age large enough to contain some board-foot volume. Each tree occupies about 242 square feet or a 15.5-foot square. It would appear, therefore, that a unit of approximately this size should be used in determining the degree of stocking in reproduction stands of western yellow pine. The proper size of unit for other types and sites can be worked out in similar fashion whereever yield and stand table figures are available.

A MATHEMATICAL APPROACH TO FOREST TAXATION[1]

By DANIEL PINGREE

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In this article the author develops formulae for determining tax ratios under several conditions, and with them compares deferred-yield and sustained-yield forests and shows the influence upon the financial set-up of changes in interest and tax rates, the introduction of a yield tax and a separate bare-land tax, and other factors.

THE PROPERTY TAX is, or should be, based on value, and value is, or should be, based on present and expected income. Neither of these relationships holds strictly in practice, but for the purpose of a mathematical analysis, let us assume for the moment that they do hold. We have, then, the following definitions and assumptions:

1. "Income" means expected net income before taxes and is assumed to accrue as of the end of the year in which received. It is money rather than psychic income.

2. "Taxes" mean property taxes levied annually at a rate r on the value as of the beginning of each year, the taxes being payable at the end of the year.

3. The "value" (called V) may be found by discounting all expected net incomes after taxes at an annual interest rate p.

4. An income Y is received from the forest at the end of every n years, n being a positive integer, and Y the gross stumpage yield minus the expenses other than taxes connected with selling the stumpage.

5. The sum of the taxes compounded at the p interest rate to the end of the income period, n, is termed X.

The problem: To find the ratio of X to Y, called the "tax ratio."

Solution: The value at the beginning of an income period is, by definition, the sum of all future net incomes discounted at the interest rate p, or in symbols:

[1]This article presents some of the tentative results of investigations being carried out by the Forest Taxation Inquiry, and is published here by the permission of the Director, Professor Fred R. Fairchild. Acknowledgment is rendered to Professor Fairchild and to Professor Irving Fisher for the foundation of the mathematical presentation used here. Professor Fisher discussed the theory of the property tax in general terms in his "*Nature of Capital and Income*" published in 1906, and Professor Fairchild the theory of the property and other taxes in relation to forests in his "*Taxation of Timber Lands*," published in 1909 in the Report of the National Conservation Commission. As to the present article, however, the author takes responsibility for the initial assumptions, the mathematical processes involved, and the conclusions reached.

$$V_1=\frac{Y-X}{(1+p)^n}+\frac{Y-X}{(1+p)^{2n}}+\text{-------}+\frac{Y-X}{(1+p)^{kn}}+\text{-------}$$

$$=\frac{Y-X}{(1+p)^n}\left(\frac{1-\dfrac{1}{(1+p)^{kn}}}{1-\dfrac{1}{(1+p)^n}}\right)$$

The limit of V_1 as k approaches infinity is

$\dfrac{Y-X}{(1+p)^n}\left(\dfrac{1}{1-\dfrac{1}{(1+p)^n}}\right)$, since the term $\dfrac{1}{(1+p)^{kn}}$ disappears as k approaches infinity. Simplifying, $V_1=\dfrac{Y-X}{(1+p)^n-1}$.

The value at the beginning of the second year equals V_1 plus one year's interest and taxes, or:

$V_2 = V_1\ (1+p+r) = \dfrac{(Y-X)\,(1+p+r)}{(1+p)^n-1}$. The first year's taxes must be added to the value since these taxes constitute an additional investment made in the property.

Similarly, the value at the beginning of the third year equals V_2 plus one year's interest and taxes, or:

$$(1)\quad V_3 = V_2\ (1+p+r) = \frac{(Y-X)\,(1+p+r)^2}{(1+p)^n-1}\text{, etc.}$$

Since the tax equals the tax rate, r, times the value, the first year's tax $= r\,\dfrac{Y-X}{(1+p)^n-1}$, the second year's tax $= r\,\dfrac{(Y-X)\,(1+p+r)}{(1+p)^n-1}$, etc., and the first year's tax, payable at the end of the year, must be compounded annually at the interest rate p for $n-1$ years to obtain its value at the end of the income period. At the end of the income period, then, it equals $r\,\dfrac{(Y-X)\,(1+p)^{n-1}}{(1+p)^n-1}$. The second year's tax must be compounded for $n-2$ years, and it equals, at the end of the income period:

$$r\frac{(Y-X)(1+p+r)(1+p)^{n-2}}{(1+p)^n-1}$$, etc. The sum of all these quantities is:

$$X=r\frac{Y-X}{(1+p)-1}\left((1+p)^{n-1}+(1+p+r)(1+p)^{n-2}+\text{.........}+(1+p+r)^{n-1}\right)=$$

$$\frac{r(Y-X)(1+p)^{n-1}}{(1+p)^n-1}\left[1+\frac{1+p+r}{1+p}+\text{.........}+\left(\frac{1+p+r}{1+p}\right)^{n-1}\right]=\frac{r(Y-X)(1+p)^{n-1}}{(1+p)^n-1}\times$$

$$\left(\frac{1-\left[\frac{1+p+r}{1+p}\right]^n}{1-\frac{1+p+r}{1+p}}\right)=\frac{r\ (Y-X)(1+p)^{n-1}}{(1+p)^n-1}\ \text{times}\ \left(\frac{(1+p)^n-(1+p+r)^n}{-r\ (1+p)^{n-1}}\right)=$$

$$\frac{(Y-X)\ [(1+p+r)^n-(1+p)^n]}{(1+p)^n-1}.$$ From this:

$$X[(1+p)^n-1+(1+p+r)^n-(1+p)^n]=Y[(1+p+r)^n-(1+p)^n],\ \text{or}\ \frac{X}{Y}=\frac{(1+p+r)^n-(1+p)^n}{(1+p+r)^n-1}$$

Carrying out the division indicated (i. e., dividing the numerator by $[(1+p+r)^n-1]$:

Formula 1.

$$\text{The tax ratio}=1-\frac{(1+p)^n-1}{(1+p+r)^n-1}.$$

This ratio of X to Y (the tax ratio) in Formula 1 represents the percentage of income absorbed by taxes. Since p and r signify the interest and tax rates, respectively, they are both positive quantities, and the fraction on the right of Formula 1 obviously decreases as n increases. Therefore, the entire right hand side of the equation increases as n increases, though no matter how high n becomes, the tax ratio can never exceed unity. In other words, the percentage of income absorbed by taxes increases the longer the period of waiting between timber crops, but it never can exceed 100 per cent under the assumptions given.

The minimum tax ratio is $\frac{r}{p+r}$ when $n=1$. That is, when the forest is on sustained yield, the same income being received annually, the tax ratio equals the tax rate divided by the sum of the tax and interest rates. If, for example, the tax rate is 14 mills and the interest rate 5 per cent, the tax ratio is 22 per cent.

An increase in n increases the tax ratio. If $n=50$ years, for instance, the tax ratio becomes 51 per cent, well over twice as much as in the case of the sustained yield forest. This is the reason for saying that the general property tax, in theory, discriminates against wealth which is appreciating in value.[2] Immature forests not on sustained annual

[2]Fisher, Irving: The nature of capital and income, pp. 249-254, 1906.

Fairchild, Fred R.: Taxation of timber lands, Report of National Conservation Commission, Vol. II, pp. 611-615, 1909.

ield generally fall, of course, in the lass of wealth which is appreciating in alue. Mature forests, however, if hese are rapidly being cut, fall in the lass of wealth which is depreciating in alue, and here the forests are favored y the property tax, as will be shown n Formula 2. The general property ax in theory, therefore, encourages the 'mining" of timber and discourages the rowing of forest crops.

To illustrate how the property tax avors merchantable timber which is eing cut, take a virgin forest in which utting is to be carried on for k years, t the end of which period all of the imber will have been removed and the are land left, for all practical puroses, without appreciable value. The efinitions and assumptions are the ame as in Formula 1, with the substiution of No. 4a for No. 4, and with he addition of No. 6:

4a. From the virgin forest there is cut annually for k years a certain amount of material yielding a net income before taxes d, the end of the k year period seeing the total devastation of the forest, the land then having zero value.

6. The value which the forest would have had at the beginning of the k year period if there had been no taxes is called W_1.

Problem: To find the tax ratio, or what is the same thing, the ratio of the net diminishment in value at the beginning of the period due to future expected taxes to W_1, or in symbols, $\dfrac{W_1 - V_1}{W_1}$.

This is, of course, equivalent to

$$1 - \frac{V_1}{W_1}.$$

olution:

$V_k = \dfrac{d - rV_k}{1+p}$ by definition, the land having zero value at the end of the k year period.

implifying: $(1+p)\,V_k + rV_k = d$, or $V_k = \dfrac{d}{1+p+r}$.

nd, $V_{k-1} = \dfrac{V_k}{1+p} + \dfrac{d - rV_{k-1}}{1+p}$. Substituting for V_k and simplifying:

$$(1+p)\,V_{k-1} + rV_{k-1} = \frac{d}{1+p+r} + d, \text{ or}$$

$$V_{k-1} = \frac{d\,[1 + (1+p+r)]}{(1+p+r)^2}.$$

imilarly, it may be shown that:

$$V_{k-2} = \frac{d\,[1 + (1+p+r) + (1+p+r)^2]}{(1+p+r)^3}, \text{ and}$$

$$V_{k-j}=\frac{d[1+(1+p+r)+\_\_\_+(1+p+r)^{j}]}{(1+p+r)^{j+1}}.$$

This may be simplified to:

$$V_{k-j}=\frac{d[(1+p+r)^{j+1}-1]}{(1+p+r)^{j+1}(p+r)}.$$ In particular:

$$V_1=\frac{d[(1+p+r)^{k}-1]}{(1+p+r)^{k}(p+r)}.$$ On the other hand,

$$W_1=\frac{d}{1+p}\left(1+\frac{1}{1+p}+\_\_\_\_\_\_+\frac{1}{(1+p)^{k-1}}\right),$$

$$=\frac{d}{1+p}\left(\frac{(1+p)^{k}-1}{p(1+p)^{k-1}}\right)$$

$$=d\left(\frac{(1+p)^{k}-1}{p\,(1+p)^{k}}\right).$$ Therefore:

Formula 2.

The tax ratio, or $1-\dfrac{V_1}{W_1}=1-\dfrac{[(1+p+r)^{k}-1]\;\;p(1+p)^{k}}{[(1+p+r)^{k}\;(p+r)]\;\;[(1+p)^{k}-1]}$.

If now, p and r be 5 per cent and 14 mills, respectively, as under Formula 1, and k be 50 years, the tax ratio is 18 per cent. This compares with 22 per cent for the sustained and 51 per cent for the deferred yield forests under Formula 1. If the virgin forest had been entirely cut-over in only 20 years, the tax ratio would have been 11 per cent, still further emphasizing the tax advantages of cutting a forest rather than of holding it for growth.

The tax ratios for different tax rates are shown for the three kinds of forests in Figure 1. The word "destruction" is used advisedly in this figure to describe what has happened all too often in America when virgin timber has been stripped from the land without proper care to secure a second crop.

Formulae 1 and 2 are thoroughly general under the definitions and assumptions given. It might now be well to examine the usefulness in practice of these definitions and assumptions.

First, psychic income was ignored, and therefore neither of the formulae applies to resort property or to property which for any reason has some sentimental or prestige value to the owner. In the case of such property, the property tax gets at an element of tax-paying ability which an ordinary income tax could not reach.

In using the word "expected" in defining income, a definite purpose of ownership is assumed. Such a definite purpose of ownership does not exist in the case of much forest land, and Formula 1 does not apply to such land. The land

may be held for eventual sale to settlers or resorters or merely for whatever may "turn up" sometime in the future. In neither case can the owner or the assessor relate the value in any intelligent way to future expected income.

It is tacitly assumed that there are no annual expenses other than taxes, no regeneration cost, and no thinnings. All of these factors can be brought into the tax ratio formula, but the result is naturally rather complicated. It is not the purpose of this initial mathematical approach to forest taxation to get immeshed with too complicated formulae, and so annual expenses other than taxes, regererenation costs, and thinnings are ignored. The inclusion of these factors would not change the fundamental conclusion that the property tax theoretically discriminates against deferred yield forests.

It is further assumed that the tax rate does not change. Of course, the tax rate frequently does change in actual practice, and a formula will now be derived showing the effect of a change in tax rate upon the value of an immature forest. The definitions and assumptions are the same as for Formula 1, with the addition of:

7. The tax rate r is unexpectedly increased to $r+u$ at the end of q years, q being less than n, but not negative.

8. The percentage drop in value caused by the tax rate increase is called z, the percentage being based, of course, on the value before the increase.

Problem: To find z, using the relationship shown in the proof of Formula 1.

Solution:

By definition, $z = \dfrac{V_q - \dfrac{V_{q+1}}{1+p+r+u}}{V_q}$, or $z = 1 - \dfrac{V_{q+1}}{V_q(1+p+r+u)}$, V_q being the value just before the imposition of the additional tax and V_{q+1} the value one year afterwards. V_{q+1} is discounted one year by dividing by 1 plus the interest rate plus the tax rate.

By analogy from (1) above

$$V_q = \frac{(Y-X)(1+p+r)^{q-1}}{(1+p)^n-1}.$$

Substituting the value of X from Formula 1, we have, after simplifying:

$$V_q = \frac{Y\dfrac{(1+p)^n-1}{(1+p+r)^n-1}(1+p+r)^{q-1}}{(1+p)^n-1},$$

$$\text{Or, } V_q = \frac{(1+p+r)^{q-1}}{(1+p+r)^n-1}Y.$$

A similar formula holds for V_{q+1} though here u must be added to p and r:

$$V_{q+1} = \frac{(1+p+r+u)^q}{(1+p+r+u)^n-1}Y.$$

Thus:

$$z=1-\frac{V_q+1}{(1+p+r+u)V_q}=1-\frac{\dfrac{(1+p+r+u)^q}{(1+p+r+u)^n-1}Y}{\dfrac{(1+p+r+u)^{q-1}(1+p+r)}{(1+p+r)^n-1}Y}$$

Simplifying, there results:

Formula 3.

$$Z=1-\frac{[(1+p+r)^n-1]\,(1+p+r+u)^{q-1}}{(1+p+r)^{q-1}[(1+p+r+u)^n-1]}$$

Assume that soon after the purchase of a forest the tax rate is unexpectedly increased from 10 to 14 mills, the interest rate being 5 per cent and the income period 50 years. Assume, further, that the tax rate increase occurs at the beginning of an income period. The decrease in value is, then, according to Formula 3, 19 per cent. If the forest had been on sustained annual yield, however, the decrease in value would have been 7 per cent, only 37 per cent as much as in the case of the deferred yield forest. An unexpected increase in tax rates is, thus, much more serious for deferred than for sustained yield forests.

Formula 3 applies just as well in case u is negative as it does in case u is positive. For negative values of u, z is negative and measures the percentage increase in value of the forest, and it will be found that z is larger absolutely the longer the income period n. Deferred yield forests are thus favored more than sustained yield forests by a drop in tax rates. From actual experience in the United States, of course, tax rates are much more likely to rise than they are to drop.

Formula 3 also applies in case u represents a change in interest rate rather than a change in tax rate. An unexpected increase in interest rate decreases the value more in the case of a deferred yield than of a sustained yield forest.

It has been shown that the property tax discourages rather than encourages forestry practice. Assume now that a pure yield tax were adopted in place of the present property tax as applied to forests. The pure yield tax is to be based on the gross income, Y (we will ignore the minor element of the cost of selling stumpage). If the yield tax rate is s, then obviously:

Formula 4.

$$\text{The tax ratio} = \frac{sY}{Y} = s.$$

Suppose that, in addition to the yield tax, a bare land tax were to be imposed at the rate r. The part of the taxes, X, due to the yield tax is sY. Each year's bare land tax is rV_1, which equals: $\dfrac{r(Y-X)}{(1+p)^n-1}$. The sum of these annual taxes at the end of the income period is:

$$\frac{r(Y-X)}{(1+p)^n-1}\left(1+(1+p)+(1+p)^2+\ldots+(1+p)^{n-1}\right), \text{ or,}$$

$$\frac{r(Y-X)}{(1+p)^n-1}\left(\frac{(1+p)^n-1}{p}\right)=\frac{r}{p}(Y-X).$$

Total taxes, X, are thus:

$$X=s\,Y+\frac{r}{p}(Y-X), \text{ or } (p+r)X=Y(sp+r), \text{ or}$$

Formula 5.

$$\text{The tax ratio } =\frac{sp+r}{p+r}.$$

If s were 20 per cent and p and r, as in previous examples, 5 per cent and 14 mills, respectively, then the tax ratio would be 37.5 per cent, considerably less than in the case of a 14 mill rate applied against both bare land and trees, but with no yield tax (example under Formula 1). A yield tax of as much as 20 per cent, combined with the bare land tax, is thus, under the given assumptions, more favorable to a forest owner than the ordinary property tax at a 14 mill rate, over a 50-year income period.

Formulae 4 and 5 do not contain n and are thus independent of the income period. The methods of taxation described by these formulae do not, thus, tend to penalize long income periods. It was shown previously that methods of taxation described by Formulae 1-3 most certainly do penalize long income periods. To the extent, then, that long income periods, and hence long rotations, are essential to the best forest practice, yield and bare land taxes are favorable to forestry.

Formula 5 applies to cases which combine a yield tax with an exemption of trees from the property tax. In a number of states, however, a yield tax is combined with a specific tax of so much per acre on forest land. The tax ratio in such states obviously varies with the yield per acre, the ratio being high for a low yield and vice versa.

If t is the specific tax, then the part of the taxes due to t is:

$$t\,[1+(1+p)+(1+p)^2+\ldots+(1+p)^{n-1}], \quad \text{or } \frac{t}{p}\,[(1+p)^n-1]$$

Total taxes, X, are thus:

$$X=s\,Y+\frac{t}{p}\left((1+p)^n-1\right), \text{ and}$$

Formula 6.

$$\text{The tax ratio} = s + \frac{t \quad [\ (1+p)^n - 1\ ]}{pY}.$$

A common combination of rates is 10 per cent on yield plus 10 cents an acre each year. If, now, n were 50 years, Y =\$100, and p=5 per cent, the tax ratio would be 31 per cent. If the yield were only \$50, however, the tax ratio would be 52 per cent. This difference indicates the inequities of a specific tax in states where the tax applies indiscriminately to both good and poor quality land.

Up to this point the discussion has been general and applies to almost any type of forest almost anywhere in the world. A specific example will now be given to illustrate some of the general principles found. For this purpose a white pine yield table from a recent official publication of the U. S. Forest Service will be used.[3] To the yields given will be applied certain average stumpage prices current in 1928 in certain New Hampshire towns.[4] Stumpage prices have, of course, increased in the past, and it is quite possible that they will increase in the future also. This possibility, however, will be offset in some degree, if not wholly, by the certainty that full stocking will not be secured, and that the yields will therefore not be so high as those given in the yield table. For purposes of simplicity, then, the various fire, disease, and other risks are assumed to balance the possibility of an increase in stumpage.

The cost of establishing a fully stocked stand of white pine by planting is \$15 an acre, and by natural regeneration plus weedings, \$8 at an average age of 8 years.[5] The cost of fire protection is 3 cents per acre per year.[6] The tax rate on full value is 21 mills.[7]

Three alternatives to the present property tax are studied in relation to this one acre of white pine: (1) a yield tax of 25 per cent, (2) a yield tax of 10 per cent plus a bare land tax at the 21 mill rate, and (3) a yield tax of 10 per cent plus a specific tax of 10 cents an acre, all at different interest rates from 1 per cent up. Since risk is assumed to be offset by the possibility of an increase in stumpage prices, interest here means pure interest only (i. e., payment for waiting).

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[3]Dana, S. T., Timber growing and logging practice in the Northeast, U. S. D. A. Tech. Bul. No. 166, Table 18, p. 72, 1930.

[4]Forest Taxation Inquiry Progress Report of March 1, 1930: Preliminary set of tables relating to forest taxation in New Hampshire, with explanatory notes and definitions, Tables 23, 25, and 27. The average values per thousand for well stocked softwood stands in Fremont and Richmond are higher than those assumed in this article, while in Loudon they are lower.

[5]Dana, S. T.: Timber growing and logging practice in the Northeast, U. S. D. A. Tech Bul. No. 166, March, 1930, pp. 23 and 24.

[6]Idem, p. 19.

[7]N. H. State Tax Commission: Eighteenth annual report, 1928, p. 15. The average tax rate is given as 28.1 mills. Assuming a 75 per cent assessment, the rate on full value is 21 mills.

Forest Taxation Inquiry Progress Report of March 1, 1930: Preliminary set of tables relating to forest taxation in New Hampshire, Table 9. The range of assessment ratios on the total of forest property for the three towns, Fremont, Loudon, and Richmond, is from 61 to 108 per cent for the year 1928.

TABLE I

ANTICIPATED YIELD FROM ONE ACRE OF FULLY STOCKED WHITE PINE IN NEW HAMPSHIRE, MEDIUM SITE

Age years	Volume *M.B.F.*	Stumpage *price per M*	Stumpage value
30	9.6	$4.00	$ 38
40	23.5	5.00	117
50	36.6	6.00	220
60	46.9	6.50	305
70	56.1	7.00	393
80	64.0	7.50	480
90	70.9	8.00	567

From Table 2 it is evident that only 3 per cent compound interest could be squeezed out of the forest planting investment under the property tax, provided the bare land could be had for $3. If one of the alternative tax systems were in operation, however, between 4 and 5 per cent could be earned on an ordinary bare land investment.

Suppose now that natural regeneration can be obtained, and that to secure proper stocking and growing conditions, two weedings are necessary at an average age of 8 years and at a total cost of $8.00. As high as 4 or 5 per cent may now be earned on an investment under the property tax, and as high as 6 per cent under other systems of taxation, at present prices of bare land.

The principles found may be summarized as follows:

1. The property tax, perfectly enforced in accordance with the law, makes the tax ratio higher in case of deferred than of sustained yield forests, and in case of sustained yield than of destruction forests, other conditions being the same.

2. The longer the income period in a forest the greater the tax ratio.

3. An unexpected increase in the tax or interest rate decreases the value of forests having a long income period more than of forests having a short period.

4. The tax ratio under a yield tax is independent of the income period or of the interest rate, and under a bare land tax, is independent of the income period, assuming, of course, perfect adjustment of bare land value in relation to expected net incomes. Under the property tax or a specific tax, the tax ratio is not independent of the income period or of the interest rate.

5. A specific tax makes the tax ratio high where the unit property value is low. This is not the case as regards the yield, the bare land, or the property tax.

6. Under tax rates usually current in the United States, the property tax is, of all common alternative tax systems, the least favorable to deferred yield forests from the point of view of income.

It might be well to sound a note of warning before concluding this paper. It has been shown that the property tax at ordinary tax rates now common in the United States is unfavorable to deferred yield forests from the point of view of income. It has not been shown that the property tax is unfavorable to deferred yield forests from the point of

TABLE 2

BARE LAND VALUES UNDER DIFFERENT TAX SYSTEMS, ONE ACRE OF FULLY STOCKED WHITE PINE IN NEW HAMPSHIRE, MEDIUM SITE

Regeneration cost C	Interest rate P	Property Tax (Rate r=21 mills)		Yield Tax (Rate s=25%)		Bare Land Tax (21 mills) Yield tax (10 per cent)		Specific Tax (10 cents) Yield tax (10 per cent)	
		Financial rotation (years) n	Bare land value	Financial rotation (years) n	Bare land value	Financial rotation (years) n	Bare land value	Financial rotation (years) n	Bare land value
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Planting $15.00 per acre	0.01	60	$39	90	$265	90	$104	90	314
	0.02	50	16	70	77	70	47	70	92
	0.03	50	3	60	28	60	22	60	34
	0.04	40	Negative	50	9	50	9	50	12
	0.05	40	Negative	50	Negative	50	1	50	Negative
Weedings $8.00 per acre at average age of 8 years	0.01	60	48	90	278	90	109	90	327
	0.02	50	25	70	88	70	52	70	102
	0.03	50	12	60	38	60	28	60	44
	0.04	40	5	50	19	50	16	50	22
	0.05	40	2	50	9	50	9	50	10
	0.06	40	Negative	50	4	40	4	40	4
	0.07	40	Negative	40	1	40	2	40	1
	0.08	40	Negative	40	Negative	40	0	40	Negative

view of criteria of tax paying ability other than income. And it has not been shown, nor is it the conclusion of the author, that the property tax is theoretically unsound as a fundamental part of an equitable tax system. Of course, it may be argued that the property tax is altogether too important a part of the American tax system at the present time, but that is another question.

$$\text{Column 2} = \frac{Y-C}{(1+p+r)^n-1} - \frac{.03}{p+r} - C.$$

Notes on Table 2

Sources of Data:

The gross yield Y is from Table 1 Column 3. Annual expenses, other than taxes, are 3 cents per acre per year.

Columns 1, 3, 5 and 7 are those rotations for which Columns 2, 4, 6 and 8 are at a maximum.

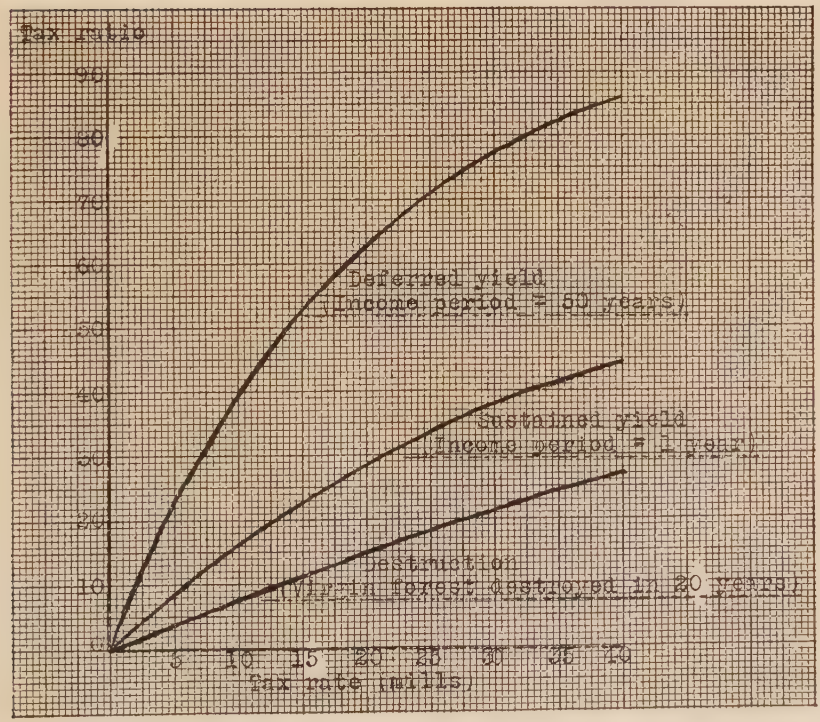

Fig. 1.—Tax Ratio Related to Tax Rate for Three Types of Forests, 5 Per Cent Interest Rate.

The first term of this expression is the present value of all future yields, minus future regeneration costs, the second term the present value of the annual expenses and the last term the present value of the initial regeneration cost. C = \$15 in the case of planting, and

$$\$\frac{8}{(1+p)^8}.$$

in the case of weedings.

$$\text{Column 4}=\frac{(1-s)\ Y-C}{(1+p)^n-1}-\frac{.03}{p}-C.$$

In this expression $(1-s)\ Y$ is, of course, the yield after the payment of the yield tax.

$$\text{Column 6}=\frac{p\,[\,(1-s)\ Y-C\,]}{(p+r)\ [\,(1+p)^n-1]}-\frac{.03}{p+r}-\frac{Cp}{p+r}.$$

This expression is derived from that immediately preceding plus the fact that the present value of the tax on bare land is $\frac{ar}{p}$, letting a represent the bare land value:

$$a=\frac{(1-s)\ Y-C}{(1+p)^n-1}-\frac{.03}{p}\ C-\frac{ar}{p},\text{ or, transporting the last term:}$$

$$a\left(\frac{p+r}{p}\right)=\frac{(1-s)\ Y-C}{(1+p)^n-1}-\frac{.03}{p}-C,\text{ and}$$

$$a=\frac{p[\,(1-s)\ Y-C\,]}{(p+r)\ [\,(1+p)^n-1]}-\frac{.03}{p+r}-\frac{Cp}{p+r}$$

$$\text{Column 8}=\frac{(1-s)\ Y-C}{(1+p)^n-1}-\frac{.03+t}{p}-C.$$

The second term of this expression combines the specific tax with all other annual expenses.

THE PROBLEM OF INTEREST IN FORESTRY

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The large amount of capital required in a forestry enterprise and the large time element involved makes the subject of the interest return important. Compound interest applies to all forests growing toward or awaiting future harvesting, but the formulae of compound interest are valid only when a safe rate is used. When the rate used is greater than the pure or time valuation rate there is a distortion of the ratio between the part of the return representing pure interest and the part representing risk or profit.

THE LONG YEARS involved in forest rotations make interest a very serious problem in forest production. Although a satisfactory definition of interest is difficult, perhaps it is sufficient to say that it is the reward of the services of capital. Some economists, indeed, restrict interest to the price paid for borrowed money. But this very limitation, implying that capitalists are not restricted to their own ventures but have the alternative of lending, is rather indicative of the validity of imputed interest. Moreover, common sense attests that capital is never ventured unless a reward for its services is either promised or anticipated.

Since interest accrues at least annually, unpaid interest becomes an increase of principal, upon which, in turn, further interest accrues, or "compounds." It is a basic trait of human nature to put a high value on present income available either for consumption or investment, and this can only be offset, in cases requiring prolonged waiting, by the prospects of receiving a compound reward. Economic experience affirms that compound interest is, both subjectively and objectively, an approximately true equivalent of simple interest paid at intervals of not more than one year.

There are three important forest conditions to consider in connection with this problem. First is the forest which must be established on denuded land, where all the costs must be paid out of resources wholly external to the forest venture itself until the end of the rotation; minor income from thinnings excepted. The second case is exemplified by a forest already upon a completely sustained yield basis; the ideal normal forest that has been brought to the maximum sustained annual yield that the policy of the owner permits, be the rotation financial, technical, or silvicultural. Here there is, presumably, income every year from the forest itself, out of which the costs of continuing (i.e. future) production may be defrayed. The third case is the overmature virgin forest, heavily overstocked with timber of a size and character that may, accidentally, fulfill an economic need. The cost of production has been nothing, but the cost of legal ownership may be very heavy indeed. The cost of acquiring and holding the legal title must come from outside resources up to the time that the economic situation

renders the timber merchantable.

Obviously these three cases merge into each other and are simplified states of all forest conditions. For example, clear cutting and planting will throw a part of a fully normal forest into the condition of a forest in process of establishment on denuded land. So also will selection cuttings, although the denuded areas are smaller and non-contiguous, but theoretically their total will be as large.

Now any silvicultural system whatever will tend to approach one or the other of the first two cases, while the overmature virgin forest is approached by allowing any second-growth forest to pass beyond the rotation age prescribed by the concious and designed objectives of its owner. In this event, however, we are no longer dealing with forest production, but with forest speculation.

From the fundamental similarity and intergradations of all forest stages and conditions, it follows that the factor of compound interest applies to all forests or parts of forests growing toward or awaiting future harvesting for any reason whatsoever. That is, compound interest applies to every expense incurred for forest reproduction, forest protection and every other expenditure made with a view to future income. This is true regardless of the source of the funds and regardless of whether the expenditures are made to establish a forest on denuded land or to continue an already organized forest.

From a strictly objective point of view there is but one form of interest, and that is loan interest, or the price of borrowed money. Now, in economic theory, the factors of production are land, capital, labor, and enterprise, and ideally, the entrepreneur rents land, borrows capital (at interest), hires labor, and applies them, together with his own business ability, to an economic venture. But, as a matter of fact, it is only in very exceptional cases that an enterprise is carried on with wholly borrowed capital. Generally a margin of security must be furnished, either in the form of indorsements, negotiable paper, chattel mortgage, or mortgage on real property. Which is to say, that in nearly every case owners capital must be employed and pledged before other capital can be borrowed.

Moreover, not only do lenders demand a satisfactory margin of security, but also proof of present or very shortly prospective earning power more than sufficient to meet the loan interest payments as they accrue. It would therefore seem that borrowed capital, and consequently loan interest, will not be a large factor in the establishment of forests on denuded lands, except, perhaps, in the case of public loans. Although it may eventually be a considerable factor in forest production in the case of organized, sustained yield forests. Even here, however, private loans will be based upon the realizable market value and current earning power of the forest, and the burden of carrying the unsaleable age classes will still fall upon owners capital.

It is elementary that loan interest rates are made up of at least two factors; safe or pure interest, which is the rate on loans devoid of chance, and an additional amount, which is compensa-

tion for the non-insurable risks involved. But, strictly speaking, the reward for bearing non-insurable risks are profits. However, profits carry no guarantee of their realization, and the actual result may be a total loss of all the capital involved. The capitalist realizing that his margin of security may be swept away, and his own capital endangered, exacts from the entrepreneur a promise to pay in the loan rate a part of the anticipated profits. It must not be forgotten that when profits fail to materialize loan interest may, and often is, paid out of the borrower's capital which was pledged to secure the loan. Consequently, for the reasons that loan interest rates include an element of profit, and may include an element of liquidation of borrowers capital, it would appear that the use of commercial loan rates in forest finance calculations is invalid, except when a specific loan is actually involved.

Subjectively there is also but one form of interest; time valuation, and the objective proof that subjective time valuation exists is the fact of loan interest. Time valuation, or imputed interest may be applied as a cost of abstinence or waiting to actual or estimated outlays, and justified by the fact that there always exists the alternative possibility of lending capital at interest. Or it may be applied as a discount to estimated future returns and costs to determine present values.

In determining subjective or imputed rates, we are limited to the approximations indicated by actual rates on substantially riskless loans. Theoretically, however, pure interest rates should be somewhat lower because no human loans are absolutely safe. Past experience of the rates on such loans is the only possible approximation that can be found.

The yield of British Consols is probably the nearest approximation available to long-term, safe interest rates over periods long enough to equal those of forest rotations. Professor Fisher on page 530 of his "*Theory of Interest*" gives a table of the yield of consols, by years, in pence per one hundred pounds, from 1820 to 1924 inclusive. Converting these figures to rates expressed in per cent, shows that starting at 4.41 per cent in 1820 the rate sank gradually but irregularly to a low of 2.45 per cent in 1897 and then rose to a high of 5.32 per cent in 1920, dropping off to 4.38 per cent in 1924. The average rate for the one hundred and five years was 3.28 per cent. Present tendencies would seem to indicate that interest rates have, in general, been declining since 1920, and it does not seem unreasonable to put the safe rate at about 3½ per cent. Certainly it is not over 4 per cent and probably not under 3 per cent.

There is only one way, however, of making either loan or imputed interest effective. That is to use it as a discount to determine present values. For the past is irrecoverable and the future unknown. Consequently past costs, however great, are gone beyond redemption if the exchange values of the present day will not cover them, and the wisdom of present expeditures can only be judged by discounting the best possible estimate of future values and future costs.

Assuming that the estimates of future values and costs is correct, discounting

them at the safe rate leaves, it is true, no profit or risk margin, and not many men are willing to engage in ventures which hold no prospect of profit. The provision for profit, however, can not properly be made by an addition to the safe rate when compound interest is involved. It is obvious that when we are dealing with net income annually paid the ratio between pure interest and risk or profit margin is always and automatically maintained. But when, as in most forestry calculations, we are dealing with accumulations over long periods of time the provision for profit and risk becomes distorted out of all proportion to the safe interest rate.

This can be shown by a simple example: Assume that the safe rate is 3.5 per cent and that doubling this will give an adequate provision for risk. Now, 7 per cent paid annually will continuously maintain the proper ratio between pure interest and profit or risk. But 7 per cent used as compound discount will distort these relations in the final return beyond all reason. One hundred dollars due in fifty years with no residual values, and assuming for simplicity no carrying charges or other costs over the original payment, will, if discounted at 7 per cent give a present value of \$3.39. If \$3.39 is paid for this right to \$100 fifty years from now, and this amount is carried forward at 3.5 per cent compounded it will amount to \$18.93, of which \$3.39 is original investment and \$15.54 interest. But one hundred dollars are due, so that instead of the return for risk and profits being in the ratio of 1 to 1 with the interest return, it is actually in the ratio of \$81.07 to \$15.54. Clearly, if double the safe rate is an adequate return for the risk involved, the actual amount received is beyond all reason.

Actually, the one hundred dollars of return should be divided into three parts, viz.: a return of the original investment; a sum equal to compound interest at 3.5 per cent (the assumed safe rate) over a fifty-year period; and a sum equal to this latter which represents profit. In the above example it would be

Principal Sum (Present Worth)	\$ 9.830
Interest	45.085
Profit	45.085
Future Value	\$100.000

This amounts to saying that deferred profits, like deferred returns of any kind, should be discounted at the time-valuation or pure interest rate. In other words the formulae of compound interest are valid only when the safe rate is used. When the rate used is greater than the pure or time-valuation rate there is a distortion of the ratio between the part of the return which represents pure interest and that part which represents risk or profit varying directly with the amount of risk coverage which is in the rate used, and the length of time involved. It is true that this distortion is not very serious (although it is appreciable) for short periods. But for the length of time involved in ordinary forest rotations it reaches wild extremes.

To correct this distortion the expression: $\frac{a}{p}\ (1.op^n - 1) + 1$ should be

substituted for $1.op^n$, and $\frac{a}{p}$ (.op) should be substituted for .op in compound interest formulae.

Where p = the safe interest rate (somewhere between 3 and 4 per cent; 3.5 per cent is here advocated).

a = p + x, or the total rate which is sufficient to include an adequate risk provision.

n = rotation.

The virgin forest is prodigal in the production of trees and shrubs but not in the production of timber. The economic values it contains are stored in relatively few individuals, in number and in volume far below the potential capacity of the soil. Against the growth of the trees stands the slow and continuous attrition by diseases and insects, by windstorms, lighting, hail, drought, and frost. The conversion of this underproducing forest into one of high productivity is the object of constructive forestry. The elimination or reduction of the factors that lower the productivity of the forest is the object of forest pathology.

E. P. MEINECKE, *in this issue.*

SELECTIVE LOGGING ON THE NATIONAL FORESTS OF THE DOUGLAS FIR REGION[1]

By FRED AMES

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This is a most timely paper. "Selective logging" as a term is common now among lumbermen and foresters. But what does it mean? To one group it connotes merely economic selection of areas, trees and logs from the financial angle; to another it includes the silvicultural aspects and places them above the economic. Mr. Ames discusses some of the interpretations placed upon the term, enlarging upon the logging engineers' idea of selection and debating its adaptability to sales of national forest timber.

THE SIMILARITY of the phrase "selective logging" to the well known silvicultural term "selection method" of cutting has led to considerable misconception as to the basic idea of selective logging. To some, selective logging means logging on an individual tree basis, taking out a tree here and there and preserving to a large extent the original, continuous crown canopy. To others, it may mean a heavy cutting of the larger trees and leaving those of smaller sizes the ages. By some the term is applied to removal of the better species and leaving the inferior species. Again, it may be understood as a system of clear cuttings, located according to a plan based upon a valuation survey, designed to determine the exact system and order of cutting which will yield the greatest financial return from the commercial exploitation of the stand.

It can perhaps reasonably be contended that the term "selective logging" is accurate and defensible as applied to all of these systems. It is, however, so similar to the standard term "selection system" of cutting that some confusion has resulted. Mr. Schlich's definition of the "selection system" will doubtless be recalled. He uses the term as applied to the natural regeneration of woods and defines it as follows:—"The age classes are evenly, or approximately evenly, distributed over the whole area of the forest. Throughout its entire extent the oldest, largest, and diseased or defective trees are year after year, or periodically, removed, followed by the springing up of new growth in small patches or single trees."

One can hardly be sure what a man has in mind when he speaks of selective logging. I saw a letter recently in which a lumberman spoke with some gratification concerning a rumor that Forest Service was adopting selective logging, but what he understood by it was that we were being more lenient with respect to leaving low grade logs in the woods during these hard times.

The reasons why foresters have rather eagerly looked to the possibilities of selective logging as an alternative to the ordinary clear-cutting methods in gen-

[1]Presented before the North Pacific Section, Society of American Foresters, at Portland, Oregon, January 23, 1931.

eral practice are clearly quite different from the end which the logging engineers advocating the system have in mind. The two approaches are quite distinct. Present methods of clear cutting offer difficult problems to the silviculturist. It has been incumbent upon him in all cuttings to make such provisions as are possible for natural reproduction. He has attempted to do this by leaving seed trees, singly, in strips, or in blocks. These seed trees have been subject to the hazards of destruction by the logging itself, from the burning of slash, from windfall, and natural death from isolation and exposure. In many stands desirable seed trees are hard to find, and often, in stands of sound timber of high quality, the leaving of seed trees has meant a considerable investment left subject to all the above hazards. The degree of success in reforestation attained by this silvicultural practice has been variable. By and large, our cutover areas are reproducing. Admittedly, however, there are distinctly objectionable features which are ordinarily attendant upon the use of this silvicultural system.

To the fire protectionist clear cutting of extensive areas also presents a problem. Although the slash following logging may be burned, the hazard of logged-off land remains high—higher by a great deal than the hazard of green timber. The more extensive these areas are and the less they are broken by blocks of green timber, the greater the hazard. Slash burning of the area logged each season is rendered more difficult if such cutting is contiguous to large areas of cut-over land even though the slash upon it has been burned once. When seasonal conditions make it impossible to burn slash with safety, these areas increase the hazard of the subsequent logging season if logging must be adjacent to such slash.

These are really the considerations in the background of the mind of the average forester which make him grasp the idea of something in the nature of selective logging as a remedy for the objectionable features of clear cutting. To him the term connotes a possible remedy or solution of the difficulties briefly outlined above.

Now let us consider the point of view of the practical logging engineer. What is it that actuates him in advocating selective logging as a measure which may be of assistance to the operator. What is the problem he is trying to solve, is it silvicultural, or a problem in protection, or something essentially different? Reduced to its essentials, the answer is simple. He is trying to tell the lumberman how he can log and manufacture a given body of timber and make the most money. It does not, of course, follow that the logging engineer is disinterested in the silvicultural and fire protection factors, but they are not an essential part of his problem. He undertakes to give the operator a scientific analysis of his raw material, an evaluation of it in such detail that by giving the correct relative weight to all factors entering into the problem, such as costs of railroad construction, costs of logging and milling, quality and mixture of species, a plan of logging can be determined which will result in the greatest possible financial return to the owner of the timber. It should be clearly understood that the problem of

the logging engineer, his approach and his solution are based upon purely financial considerations, and of course quite properly so.

Mason and Stevens, in the introduction to one of their reports, give the following explanatory statement of what a selective logging analysis can be expected to show. They say—

"Following a careful analysis it is practicable to apply the selective principle in the forest in the following ways:

"1. To determine which, if any, portions of a property are so poor in values that they will not justify railroad development.

"2. After railroad development, to determine which, if any, sub-units of area will not justify setting and rigging donkey equipment.

"3. After a small unit of area has been developed by building the railroad and setting the donkey, to determine which individual trees cannot repay the subsequent costs necessary in converting them into saleable products.

"4. After the selected trees have been felled, to determine before bucking which logs cannot repay future costs.

"5. After the logs have been bucked and the ends of the logs exposed, to determine which are so unusually defective that they cannot repay future costs.

"In all of the above, selectivity has been suggested as a means of eliminating the heavy losses existing, although more or less concealed by lack of definite information, in practically all present-day lumbering operations. But selectivity should not stop there, for the full financial success of an operation depends not only on eliminating losses but also upon extracting existing realizable values in such an order with respect to *time* that such values when discounted to the present, give the maximum present worth.

"The feasibility of economic selection depends upon there being differences in realizable values between different units (such as units of area, trees and logs) which the selection process may recognize and act upon. The greater the differences in realizable values, the more favorable the opportunity for selection."

As can be seen, the plan makes a selection of areas to be logged and those not to be logged, determines the order of logging, selects the trees to be cut, and selects the logs which, from the standpoint of size and soundness, should be removed.

No attempt will be made to explain the involved calculations by which the logging engineer arrives at his conclusions, but perhaps the above outline of principles will serve to point out the essentials of his plan.

Now that we have in mind the two approaches which I have chosen to call the points of view of the forester and the logging engineer, we might inquire for a moment as to the chief points of interest which selective logging has for a forester.

In the first place the forester is interested in any favorable effect which selective logging may have upon the lumber business. It is believed that failure to apply the principles of scientific research has contributed much to the ills to which the industry is subject, as manifested in such ways as the too rapid exploitation of the virgin stand in the region, resulting in overproduction, low standards of utilization and heavy operating losses. These in turn have undoubtedly had a retarding effect upon the progress of forestry. Therefore, foresters should look upon selective logging as a development deserving encouragement.

Again, it may be observed that the direct silvicultural effect of a typical application of the system can hardly be other than a desirable contrast to average clear-cutting methods. Nothing could be worse silviculturally than the typical clean cutting of extensive areas without any provision whatever for regeneration. Any plan entailing scattering of cutting units will be of advantage from the standpoint of seed supply to cut-over areas. Slash burning will also be facilitated and the likelihood of recurrent devastating fires sweeping over large areas of cut-over land will be lessened.

It is the effort of selective logging upon utilization which seems to be most questionable from the standpoint of the forester, and a whole field of debate seems to be opened up as to what constitutes good utilization. This will be discussed more at length a little later.

The question which probably will be asked is whether the logging engineer's plan is adaptable to sales of national forest timber. If by it the operator makes more money, why is it not also of advantage to the Government since presumably larger profits would be reflected in higher stumpage prices? The difficulties would arise in the attempt to harmonize certain of the essential ideas of the plan with the ideals and aims of a forester, and also in devising a practicable sale procedure which would be adaptable to such a plan of logging.

Considering first the matter of area slection. The Forest Service is now and has many years practiced selective logging in both a very broad way, and also in a more restricted sense comparable to what the logging engineer contemplates. From the broad point of view, the forest properties of the government as contained in the national forests of the Douglas fir region, form a managerial unit within which cuttings are located here and there on different national forests. When a decision is made to sell a certain unit of timber, whether it contains ten million feet or several hundred million, theoretically the same considerations apply which the logging engineer brings to bear in making his decisions as to the location, order and time when his smaller subunits shall be cut. Obviously, the same intensity of calculation is not used and as we all know, there are often conflicting factors which have a bearing on the decision to sell, but fundamentally the end sought in both cases is the same. The application of the selective principle by the Forest Service stands out more clearly in decisions which have been made not to sell timber which has been applied for, sometimes insistently. Few realize that during the past five years, for example, we have refused to sell over 4,600,000,000 board feet of timber which has been applied for by responsible parties. These decisions have been based very largely upon economic grounds and our judgment of the time when the units concerned would have the highest realizable value.

In the more restricted sense also, we have practiced selective logging. Sales boundaries have been drawn to include largely only areas of positive value. The effort has been made so to locate boundaries that areas of upper slope timber will be left in practicable operating units, and in some cases areas

of positive value are left in order to round out such blocks. Within sale areas sub-units of negative value are often left unlogged. This is all true economic selection even if we have not called it by that name.

It should be pointed out that a selective logging plan based purely upon the principles already described might, or might not, fit in with desirable silvicultural objectives, depending upon the character of the stand. As stated above, "The feasibility of economic selection depends upon there being differences in realizable values between different units, (such as units of area, trees and logs) which the selective process may recognize and act upon." In other words, a uniform stand in all essential respects would call for no different treatment, as to order of cutting, than is now the common practice.

It would seem that in the matter of tree and log selection, some conflict of interest might appear between the end sought by the logging engineer and the ideas and standards of utilization commonly held by foresters. The question of the soundness of the basis for recognized standards would very likely be involved. As is probably known, our present utilization standards are based upon the practice of the most progressive operators and perhaps in some respects requirements are somewhat in advance of them. They are determined to a considerable degree by the large size of the timber and the heavy powerful machinery necessary to remove it. However, as Mr. Hodgson[2] and others have shown, utilization is far from being complete on either private or government lands. Economic selection would, in the average case, almost certainly mean a considerably less intensive degree of utilization than we now have, since in part it is based on the idea that at the present time, in the usual case, proper selection of trees and logs according to their positive or negative value is not being made, and that no trees should be cut and no logs removed except those which could be handled at a profit. Of course, the question can be raised and it can be argued that there is no gain to any one if timber is taken from the woods and manufactured and sold at a loss, and that utilization standards based on anything other than profit are arbitrary and without a logical foundation. Bearing on this it may, however, be pointed out that broad questions of public policy are involved. From the standpoint of a national timber supply, the question will be asked whether our timber should be sold at all if to do so at a profit means lowering our present incomplete standards of utilization. A balance has to be struck somewhere between the factors pointing toward sales of national forest timber, such as overmaturity, influence of adjacent private logging, revenues to government and counties, and the opposing factor of incomplete utilization. I anticipate that there would be considerable question whether any lowering of standards would be chosen in favor of increased returns.

Economic selection would in some stands mean the early removal of the units containing the more valuable spe-

[2]Logging waste in the Douglas Fir Region. By Allen H. Hodgson. Published serially in *Pacific Pulp and Paper Industry* and *West Coast Lumberman*, Seattle, Wash., January, 1930.

cies and the leaving of units composed of inferior species, or perhaps the culling of the more valuable species from the whole stand. The influence of such logging would be in the direction of a deterioration of the stand from a silvicultural point of view and therefore undesirable. However, I do not think that it is worth while placing much emphasis on this point since any discussion of it is bound to be entirely theoretical.

Now as to a few aspects of sale procedure: As you probably know, our present appraisal system is built up on averages. Prices are determined by an averaging of such factors as logging costs, quality and lumber prices, the first two being related to the particular tract under consideration. This being so, the stumpage price as applied to a large sale will theoretically be low for the more valuable sub-units and high for the less valuable. This generally works out fairly equitably following customary logging practice. If, however, under such an averaged price system the operator were to go into a tract and follow a plan by which he would remove all the most valuable timber during the early years of operation, the government might very likely be left "holding the sack" at the end of that time. Some form of procedure, by which prices would conform to the relative value of sub-units, or some other form of protection for the government would have to be devised. To relate prices accurately to a large number of sub-units would involve an appraisal problem which could not be attempted without a plan of selective logging. I know that as such plans are now conceived of by logging engineers, the cost factor alone puts them far beyond our reach at the present time.

Something is being heard of the possibilities of single tree selection as an alternative to clear cutting. It is the judgment of our logging engineers that in the national forests this system now offers only very limited possibilities. In steep country where timber is large, I am very doubtful of the feasibility of such practice because of the apparent necessity of employing heavy high-powered machinery. Possibly future developments in machinery and methods will change this situation. On favorable slopes where caterpillar tractors can be used and in the second-growth stands of the future, I look to see the system employed.

To the forester who is looking for some answer to the silvicultural and fire control problems which are now his chief worries, I believe that a modification of the clear-cutting system, which might be described as logging by scattered settings, holds out the most promise. The object would be to avoid creating extensive areas of cut-over land, such as result when cuttings sweep progressively through a sale area, and rather to scatter cuttings so as to have each area wholly or partially surrounded by uncut timber, thus promoting the chances of natural reforestation and diminishing the difficulties of slash burning. The possibilities of the employment of this system would, of course, be limited by the size of the sale. Possibly the location and order of cutting of the sub-units could be made to fit in with some modified economic selection. The difference between such a scheme and a system of logging by eco-

nomic selection would be merely one of approach, the silvicultural aspects of the problem dominating the financial.

I believe it quite likely that there will be interesting developments along this line in the next few years.

THE KILLING OF TREES WITH SODIUM ARSENITE[1]

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Foresters are called upon to kill trees as well as to grow them. The killing of undesirable specimens from roadside or fields and from forests for thinning or improvement purposes may be accomplished by the use of tree-killing chemicals. The authors report here their experience with arsenical compounds, especially a 2-pound sodium arsenite solution, and they describe a new tool, especially devised for making incisions and introducing the poison, which reduces the cost of treatment.

The Need and Uses for Chemical Tree Killers

As PRACTICING foresters, we have all come up against the problem of the effective and permanent removal of certain tree growth, either where some other use of the land is desired or where other species are to be favored.

The simple expedient of cutting down the undesirable tree or trees with an axe is effective with the conifers, and with large sized hardwoods which have lost their sprouting capacity. In general, however, this method is very far from answering the real needs of the situation because most of the woody growth it is desired to destroy permanently is of broad-leaved species that sprout vigorously and persistently. Cutting in August is not always effective in killing the roots even though the fall sprouts are winter-killed.

In New York State one of the most outstanding examples of the need of a cheap and effective method of getting rid of woody growth is to be found in the case of the thorn apple and wild apple which in certain sections are rapidly seeding in on pasture land rendering such land valueless either for dairying or forestry. Specifically in Madison, Cortland, Jefferson, Oswego, Allegheny, Cattaraugus, and Chautauqua counties there are thousands of acres of hillside pasturage where these two species are in complete possession of the land. Typical areas have been examined where there were as many as 600 clumps to the acre, ranging in height from 2 to 15 feet.

In the case of individual trees and other woody growth, a forester, and particularly an extension forester, is often confronted with requests for information as to how they may be destroyed. For example property owners are interested in the elimination of Carolina poplars within the limits of towns which have just legislated against this aggressive species, or the removal of a spreading elm that offers too much shade to a suburban garden, or killing poison-ivy along walks or soft maple sprouts along the roadside. Owners of power lines are interested in keeping their rights-of-way through the forest free of sprouts. All

[1]Presented at the winter meeting of the New York Section, Society of American Foresters, at Albany, N. Y., Feb. 6, 1930.

these problems may be solved by a chemical that will kill woody growth.

Turning to the field of silviculture we find that an efficient tree killer would serve a wide variety of purposes such as (1) the prevention of sprouting of inferior species in the case of the regeneration of stands by clear cutting, (2) the prevention of sprouting of all species where more desirable advance growth of seedling origin is abundant, or (3) where inferior hardwoods are removed to convert an area to conifers by planting, (4) the elimination of an understory of undesirable species which prevents the establishment of seedlings of desirable kinds particularly in connection with shelterwood and selection cuttings, (5) the elimination of left-over unmerchantable trees of poor quality remaining after a commercial cutting, and (6) the elimination of volunteer growth on old field planting sites.

The Chemical

The potency and effectiveness of arsenical compounds as poisons to plant and animal life have long been recognized. A number of manufacturers have produced arsenic compounds to be used in keeping down weeds along railroad rights-of-way, about factories, oil tanks, and the like. Some of them have recommended their preparations for the killing of trees. The most common form in which arsenic has been used for these purposes is sodium arsenite.

Most of the commercial tree-killing preparations of sodium arsenite are of 4-pound strength in solution, that is, they are guaranteed to contain the equivalent of 4 pounds of white arsenic per gallon, though they vary in the amount of sodium hydroxide used. The active poison is thought to be arsenious acid ($H_3As\ O_3$). If so, the function of sodium hydroxide is to bring the arsenious acid powder, which is insoluble in water but which dissolves in alkali, into solution. It is probable that the arsenious acid (As_2O_3) and sodium hydroxide (Na OH) combine in water to form a series of sodium arsenites which dissociate to form more or less sodium hydroxide (Na OH) and arsenious acid ($H_3As\ O_3$) in solution. If this is so, it is important that only as much sodium hydroxide be used as is needed to bring the arsenious acid powder into solution. Careful tests with barberry plants made by the U. S. Bureau of Plant Industry showed that arsenious acid in solution was two to four times as effective a killer as sodium arsenites or arsenates, so that a minimum of sodium hydroxide should be used to insure a maximum of dissociation.

As a result of experiments to be discussed in this paper, the authors are recommending for use as a tree killer what might be termed a "two-pound arsenite", that is, a solution which contains the equivalent of two pounds of white arsenic (As_2O_3) per gallon. A tree-killing solution of about this strength may be prepared in several ways. The choice will depend upon the availability of various chemicals. These ways may be listed as follows:

1. By mixing together 2 pounds of white arsenic [arsenious acid (As_2O_3)], 0.5 pound of sodium hydroxide (Na OH) and 1 gallon of water.

2. By dissolving 2.5 pounds of com-

mercial sodium arsenite powder in 1 gallon of water.

3. By diluting 1 gallon of 4-pound commercial liquid sodium arsenite with 1 gallon of water.

4. By diluting 1 gallon of 8-pound commercial sodium arsenite with 3 gallons of water.

Costs of sodium arsenite vary widely. The lowest prices quoted the authors have been \$0.60 per gallon for 4-pound strength, making the cost of the recommended concentration \$0.50 per gallon; and \$0.10 a pound for sodium arsenite in powdered form making the cost per gallon \$0.25.

Sodium arsenite, as a tree killer, apparently first received the attention of foresters in this country as the result of the publication by the U. S. Forest Service of a formula developed in Australia. This formula called for one pound of white arsenic, one pound of washing soda ($Na_2Co_3H_2O$) or 0.5 pound of caustic soda (sodium hydroxide), 0.5 pound of whiting [calcium hydroxide—Ca $(OH)_2$], and four gallons of water. That the results obtained by the authors and others in its use have not been uniformly successful may be attributed primarily to defects in this formula. These defects are, first, that the solution is too dilute for use by the methods herein recommended (it should contain from 6 to 8 times as much of the active poison), and second, that upon standing the whiting, "added merely to serve as an indicator of the trees treated, as it turns white on drying" combines with the active ingredients to form a series of calcium arsenites which are relatively insoluble.

In 1927 a preparation known as Thorn Apple Poison was sold in Cattaraugus County at \$5.00 a gallon. An examination of some fifteen-foot thorn apple trees which had been treated with this poison during August, showed that it had been 100 per cent effective. The poison had been introduced into slashes made in the stem on two sides of the tree. A sample of the poison was secured and analyzed by Dr. Brown of the chemistry department at Cornell University and showed the following approximate proportions by weight:

Sodium arsenite	20 per cent
Potassium nitrate	8 per cent
Water	72 per cent
Total	100 per cent

This killing solution, it was subsequently learned, was concocted by a druggist evidently with some knowledge of the arsenites. In its arsenic content it approaches the two-pound strength recommended by the authors. The function, if any, of the saltpeter is not definitely known. It acts independently from the arsenite, and may possibly have some effect in speeding up the diffusion of the arsenite. The old tradition that the rotting of a tree stump is hastened by boring a hole and filling it with saltpeter most likely accounts for its introduction into the solution. The results obtained, however, with that particular combination and proportion of chemicals was so effective in the Cattaraugus experiment that the same proportions have been used in certain thorn apple killing demonstration plots that have been established in Allegheny, Cortland and Cattaraugus counties.

In actual practice it has been found satisfactory to mix 1 pound of sodium

arsenite and one-half pound of potassium nitrate in 3.5 pints of water. This gives a killing solution of the approximate strength shown in the original poison.

Test of Sodium Arsenite in Eradicating Thorn Apples

The thorn apple trees (*Crataegus* sp.) killed so effectively in Cattaraugus County, had been slashed with an axe on only two sides of the stem and the poison injected into these cuts with a long-spouted oil can. This treatment, however, was carried on during August when the vigor of the tree growth is at low ebb. Seasonal experiments carried on by the authors subsequently on individual thorn apples of varying diameters indicated that the best results were obtained when enough incisions around the stem were made, so that there was not more than one inch of uncut bark and cambium between the edges of the incisions. This permits of faster work than the so-called Australian formula, where complete girdling is required; at the same time it calls attention to the fact that the lateral diffusion of the chemicals can not be expected to be greater than one-half inch beyond the edge of the incision in the case of thorn apple. In other species the poison may diffuse to a greater or less extent.

In order to get some idea of the cost of treating thorn apple on an area basis and also to determine what effect, if any, the season of the year had on the effectiveness of the poison, a one-acre plot was laid out in a thorn apple infested pasture in the town of Cuyler, Cortland County. This acre was subdivided into 4 quarter-acre plots, and these were treated at successive three month intervals, viz., November, 1929, February, May and August 1930.

The thorn apples in the particular pasture under treatment, were of the bushy type ranging in height from one to eight feet and with thorn infested branches clear to the ground. This condition necessitated the use of a brush hook in cutting away the side branches in order to get access to the main stem for the injection of the poison. A hand axe to make the incisions and a long spouted oil can of 1-pint capacity completed the equipment. Two men were required to do the work; one to make the incisions, and the other to follow with the oil can to inject the poison into the incisions.

On the two quarter-acre plots treated in winter conditions, November and February, in which the visibility was better because of the lack of foliage, an average of 2.5 man hours were used in treating a quarter acre on which there were 120 thorn apple clumps. One-half gallon of solution per quarter acre was used.

Translating these figures to an acre basis, and allowing 40 cents per hour for labor, the following general statement is deduced.

Where clumps of brushy thorn apple are treated in the winter condition, the labor cost will be $4.00 per acre and the chemical 56 cents, or a total cost of $4.56, for fields running around 500 clumps per acre. It is obvious that fewer clumps per acre would reduce the cost. Furthermore, if the large type of thorn apple, where access can be had to the main stem without the necessity

of brushing, is to be dealt with, the time required to do the work is less.

In the plots treated when the thorn apples were in leaf, May and August, the time was increased by two man-hours per acre due to the fact that the main stems were completely hidden by the foliage. This difficulty would not occur in the more tree-like forms of thorn apple.

Seasonal Effectiveness of the Poison

The 4 one-quarter acre plots treated at 3-month intervals showed the results shown in Table 1 when inspected October, 1920.

Table 1

SEASONAL EFFECTIVENESS OF THE POISON

Treatment	Per cent dead tops	Per cent live tops	Per cent sprouting
November	95	5	0
February	70	30	5
May	12	88	10
August	94	6	0

In the November plots an examination of the few trees which were alive (one or more live branches) showed that in every case the edges of the incisions were more than one inch apart. In the May treatment only those small trees which had been practically girdled in the course of making the incisions showed a completely dead top. Incisions were improperly spaced on a few of the trees treated in February, but a considerable number with proper spacing had survived also. The survival of trees with incisions properly spaced was greatest in the May treatment as was the vigor of the sprouting observed the following October. It is not yet possible to determine the degree of sprouting which will occur following the August treatment. On the basis of the original work done in Cattaraugus county, however, it is to be expected that no sprouting will result.

Tests of Sodium Arsenite in Silvicultural Practice

The authors' experiments with the use of sodium arsenite as an aid in silvicultural management have been attended by various degrees of success. The earlier tests starting with the Australian formula as a basis in some instances gave good results.

The first test, using the Australian formula, involved the treatment of hop-hornbeam (*Ostrya virginiana,* Koch) which hindered the establishment of regeneration under an oak-hickory-pine stand in the process of regeneration by the shelterwood method. Twenty-six stems from one to three inches in diameter at the base, were treated April 2, and 20 more of similar size on June 5, 1925. Only six of these 46 sprouted from the roots (very weakly). Of 20 cut in the same manner, but not poisoned, 18 sprouted vigorously. The method of treatment was to make small axe cuts or frills around the stem and to introduce the posion by means of a swab (rag tied on a stick) or to cut the stem off clean leaving a slanting stub onto which the poison was swabbed. The former method, leaving the original stem attached to the root system until the sapling was killed, was time-consuming, but gave 100 per cent killing. The six trees which sprouted weakly were all treated by severing the stem

and swabbing the stub.

The next experiment, using the Australian formula, was designed to determine the time of year at which treatment is most effective. It involved over 2,000 seedlings and saplings one-half to four inches d.b.h., including nine species of which aspen, black birch, pin cherry, and red maple were the most important. The experiment was carried out in a young stand on a recent burn. The method was to cut off all the stems on two plots each month swabbing poison on the cut stubs of one plot, retaining the other for a check. Monthly cuttings were carried out from October to June inclusive, producing nine pairs of plots. The project was abandoned in July because all of the poison plots showed a large amount of sprouting. Further tests of this kind with higher concentration of poison will be tried. While the above test was useful chiefly in showing that the Australian formula is too dilute, it did indicate something as to the best season of treatment. It was quite apparent to the eye two years later, that there were fewer sprout stems on the areas treated from October to January than on those treated subsequently. This coincides with the results obtained with thorn apple. That the difference was not due to the season of cutting, irrespective of the poison, was evidenced by the condition of the cut but not poisoned control plots.

That the tests just described were less successful than those with hop-hornbeam must be ascribed either to species characteristics or to the fact that the hop-hornbeam was shaded while the young stand in the burn area received full sunlight.

An experiment with 2-pound strength arsenite is suggestive of the effectiveness of this concentration. In its application two methods were used, namely axe cuts and auger holes.

In the auger-hole method a three-quarter inch hole slanting downward was bored into the stem near the root collar, to an average depth of 1.5 inches.

TABLE 2
SODIUM ARSENITE ON ASPEN
TEST OF AUGER-HOLE AND AXE-CUT METHODS
2-pound strength

D. b. h.	Complete kill per-cent	Top killed weak sprouting per-cent	Nearly dead no sprouting per-cent	Less than one-half crown dead no sprouting
		Auger-hole method		
2	31	2	1	5
3	28	3	12	3
4			3	10
5				2
	59	5	15	21
		Axe-cut method		
1	12			
2	18			
3	26	5	1	
4	14	7		
5	7	3	3	
6	4			
	81	15	4	0

The axe-cut method consisted in making deep cuts slanting into the base of the tree near the ground level, so spaced that not more than one inch of unsevered bark remained between the edges of adjacent cuts.

It is shown in the table that by the auger-hole method 59 per cent of the trees were killed outright, and an additional 20 per cent so weakened that they would no longer provide serious competition. The effectiveness of this method, it will be noted, decreases as the diameter of the tree increases.

By the axe-cut method 81 per cent of the trees were killed outright and the remaining 19 per cent so weakened as to be virtually eliminated. The use of an auger hole in poisoning is not recommended, for it is more difficult and time consuming to apply, and is less effective.

The ultimate effect of more recent poisoning on larger material (aspen, black birch, pin cherry, red maple and beech), can not yet be determined. Trees of these species from two to six inches in diameter treated by the axe-cut method in September 1930, showed blackening and withering of the foliage within six days, but the extent to which the root systems have been killed will not be apparent until midsummer of 1931.

A Tree Killing Tool

The analysis of the costs of treating thorn apple trees with poison, shows that the item of labor is the greatest expense. It seemed desirable, therefore, to devise means of reducing the labor cost, in order to make the work of killing thorn apples less expensive. If the work could be effectively performed by one man rather than two the cost per acre would be cut almost in half, because the labor item represents 87 per cent of the entire cost of treatment.

After considerable experimenting a tool which permits one man to do the entire job, without any appreciable increase in time consumed, was developed with the help of the department of rural engineering at Cornell University. (Figure 1.)

This tool consists of a 5-foot length of 1.25-inch wrought iron pipe, the upper four-fifths of which acts as a reservoir for the poison. The pipe is cut in two at the 4-foot point and a 2-inch brass cylinder is sweated into the lower end of this 4-foot section. This cylinder has a one-half inch core removed from the center. Two valves are fitted to a one-eighth-inch wire which passes through the cylinder and up through the barrel and screw cap. These valves are so spaced that when the upper valve is seated in the top of the brass cylinder, thereby preventing the escape of the solution, the lower valve is open. This is the normal position of the valves. A coil spring fastened to the wire at its upper end just below the cap of the barrel keeps this upper valve closed. A slight pull on the button which terminates the wire just above the cap, opens the upper valve and closes the lower valve, permitting the core of the brass cylinder to fill with about a teaspoonful of the solution. When the button is released the upper valve closes and the solution in the brass cylinder flows past the open lower valve.

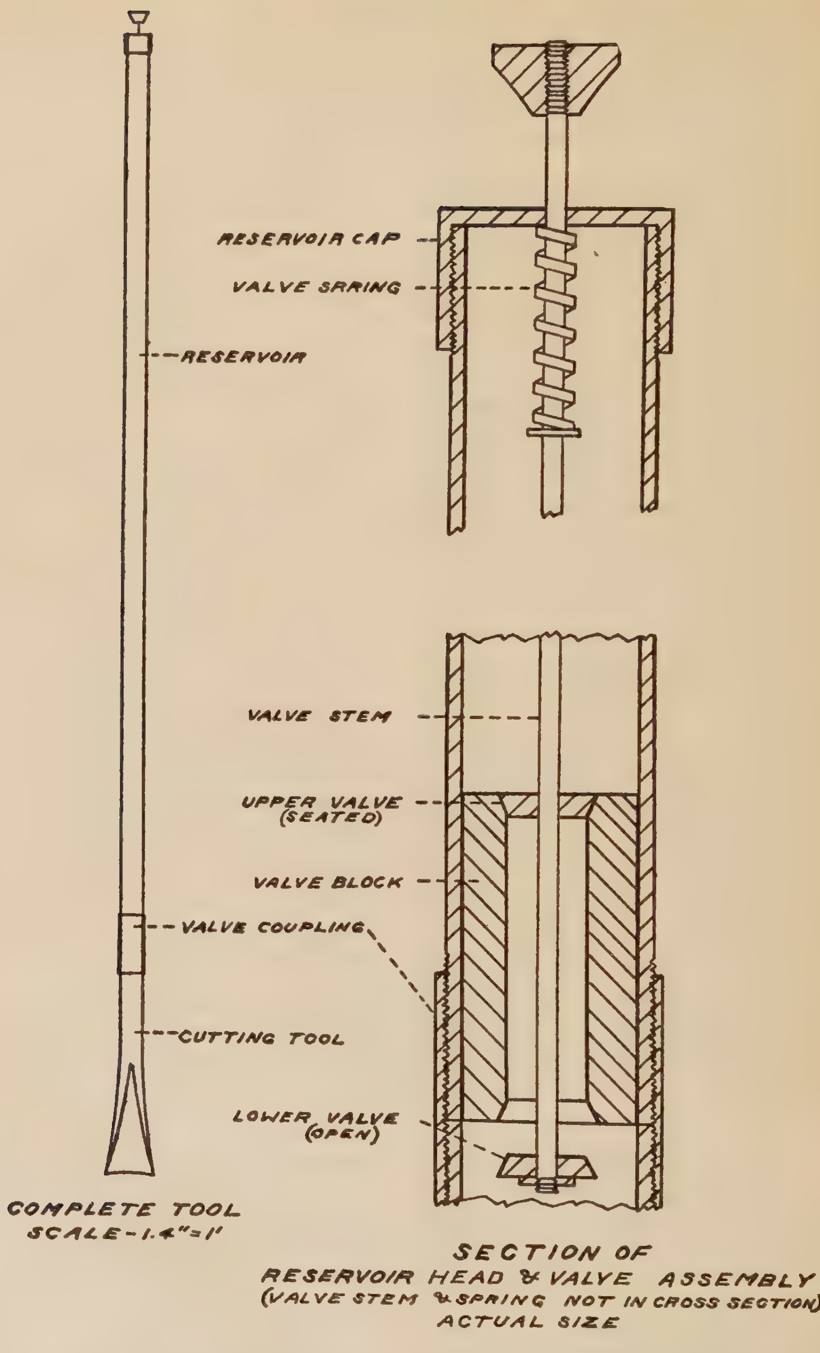

Fig. 1.—Special tool for making incisions and introducing poisons into trees to be killed.

The lower one-foot section of the 5-foot pipe is made into a cutting tool. It is slit open for six inches and flattened out into a crescent-shaped gouge-like cutting edge about 2.75 inches broad. The up-turned edges of the tool prevent lateral loss of the poison on its journey from reservoir to the tree, and also provide an incision from which the poison does not easily run. Furthermore, the cutting edge is hollow ground, so as to give a concave surface, hardened and tempered.

The upper end of the cutting tool and the lower end of the reservoir are threaded and joined by a 2-inch coupling. The reservoir is filled by unscrewing the cap.

In operation, a downward thrust with the tool makes the incision. While the cutting edge is still imbedded in the tree a quick pull and release of the wire permits a measured quantity of poison to flow directly into the cut.

This tool has the advantage of being easily and cheaply made and is sufficiently stout to stand up under the strain of the work it is required to do. The weight of the tool makes it easy to drive through side branches and strike home at the base of the main stem, and the conclave edge of the tool is more effective than the convex edge of such a tool as an axe, when applied to the convex surface of a tree trunk.

Summary

The results of tests with arsenite described above lead to the following conclusions and recommendations:

1. A two-pound strength of sodium arsenite [the equivalent of 2 pounds of arsenious acid (As_2O_3) per gallon] is effective and economical in killing trees.
2. The best method of application is to introduce the poison into cuts made (with axe or tree-killing tool) as near the root collar as possible.
3. Not more than an inch of unsevered bark should be left between the edges of adjacent cuts.
4. Poisoning is most effective if done between August and December.
5. Poisoning of standing trees is more effective in killing root systems than the poisoning of the stumps or stubs of trees recently cut.
6. In the elimination of thorn apple from pastures, the use of sodium arsenite has been proven to be economically justifiable.
7. The results secured in using sodium arsenite for silvicultural purposes are sufficiently promising to justify further investigation.

CONTROLLING THE PROPORTION OF SUMMERWOOD IN LONGLEAF PINE[1]

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It is not enough to know how to increase the volume growth of trees; the properties of the resultant wood must also be considered. The influence of artificial irrigation and fertilizing upon diameter growth and on the proportion of springwood and summerwood, the latter an indicator of density and strength in the case of conifers, was studied by the author. He found such treatment to increase the rate of diameter growth and the proportion of summerwood. Although such artificial treatment is hardly practicable, the experiment indicates that silvicultural measures should be designed to develop forest conditions favorable to the retention of natural moisture and to building up the soil fertility.

IN THE southern yellow pines the weight of the wood and accordingly its mechanical properties are determined largely by the relative proportion of springwood and summerwood in the annual growth layers that make up any particular piece of wood. This article gives the results on an experiment conducted by the Forest Products Laboratory to determine the effect of water on tree growth in order to learn if the proportion of summerwood could be increased and to determine also to what extent the amount of springwood and summerwood in the annual growth ring might be affected by the application of certain commercial fertilizers.

The Experimental Area

The experimental area was located in the Choctawhatchee National Forest, Florida, where the following conditions existed:

1. The soil at the site was of a deep and nearly sterile Norfolk sand, showing upon test only traces of available nitrogen and phosphorus. It contained normally only about 5 per cent as much potassium as an average soil of good agricultural quality.

2. On account of the porous nature of the soil very little water was retained either in the surface layers or in the subsoil.

3. Near the site was a plentiful supply of fresh water in spring-fed Garnier Creek, which flows in a narrow depression 60 to 75 feet below the general level of the area. The position of the springs indicates that there are no impervious soil layers above the ravine bottoms.

4. Longleaf pine (*Pinus palustris* Miller) trees of mature age and size but

[1]The authors acknowledge assistance, as follows: Dr. A. I. Weinstein helped to establish and to supervise the experiment during the first year, Stanley C. Nelson supervised the fertilizing and watering for three months during the summer of 1927, and Dr. J. Elton Lodewick during the summer of 1928. Since 1928 these operations have been supervised by Eugene Gemmer of the Southern Forest Experiment Station. The soil analysis was made under the direction of Professor Emil Truog of the University of Wisconsin. L. M. Weyker assisted in the determinations of soil fertility.

[2]Maintained at Madison, Wisconsin, in coöperation with the University of Wisconsin.

of extremely slow growth were at hand within a distance of less than 1,000 feet from the stream.

The area selected, about 10 acres, is on the east bank of Garnier Creek, approximately 3 miles in a northerly direction from Camp Pinchot Ranger Station, where the rainfall records used in this report were obtained. The Gulf of Mexico is about 8 miles directly south of the area.

The experimental area has been a part of the Choctawhatchee National Forest for approximately 20 years. Although some fire protection has been given the region, it has not been free from forest fires. At the beginning of the experiment, in the spring of 1927, it was estimated that this area had not been burned for at least 4 years. A fire line was raked around the 10 acres to prevent fire damage to the experimental trees. The experimental plot has been protected from fire since the start of the experiment.

Trees and Vegetation

Forest fires have prevented the development, on the experimental area, of tree species other than longleaf pine and oak sprouts. A few scattered shrubs are present, and a light growth of grass and herbaceous vegetation occurs on space not otherwise occupied.

The longleaf pine trees on the area range in age from 100 to 250 years and in size from 6 to 22 inches diameter breast high. The trees average about 60 feet in height and the bases of their crowns average about 30 feet in height. Most of the trees are of medium or good vigor with crowns of thick foliage density. The crowns average about 20 feet in breadth and length and are mostly dominate.

Position of Root Systems

The root systems of trees near the experimental area, which were exposed intact by hydraulic means, show that by far the greater portion of the longleaf pine roots occupy the upper 18-inch layer of the soil.[3] The roots of the longleaf pine, scrub oak, and other shrubs occupied this layer so thoroughly that the competition for the limited supply of plant food in the soil and of water retained after rains patently is very keen.

Precipitation

Since 1913 the region has had an average annual rainfall of 60 inches or more, but in spite of this fact seasons of extremely low rainfall do occur, and, further, the precipitation at times consists largely of heavy rains or extreme downpours at such infrequent intervals that the soil does not retain sufficient moisture for normal tree growth. The low moisture capacity of the sandy soil, coupled with warm summer temperatures, brings about conditions that are not much more favorable for growth than those existing in semi-arid regions.

Figure 1 shows the precipitation during the seasons of principal growth, March 16 to June 15, and June 16 to October 15, for the years 1913 to 1929, inclusive.

[3]Gemmer, E. W. The Root System of Longleaf Pine. Science 27: 384, Fig. 1, 1928.

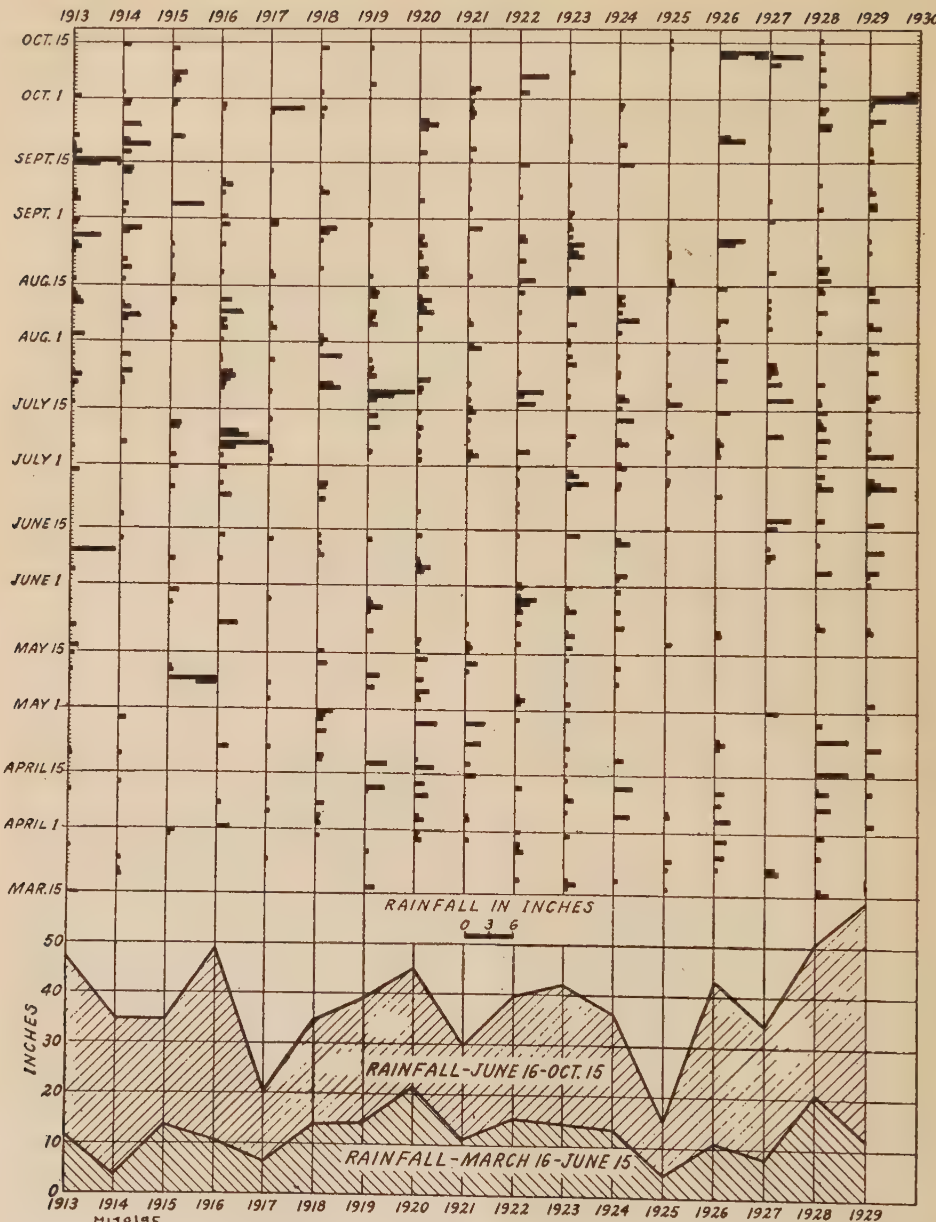

FIG. 1.—Chart shows daily precipitation of 0.25 inch or more, March 16 to October 15, for the years 1913 to 1929. Curves show total precipitation March 16 to June 15 and June 16 to October 15 for the same years.

Moisture-holding Capacity and Fertility of the Soil

As already mentioned, the water-holding capacity of the soil is very low. Moisture determinations made 2 days after a rainfall of 1 inch showed a moisture content of only 2-2/3 per cent at depths up to 6 feet. Similar tests 2 days after a 3-inch rain showed the moisture content at the same depths to be about 5 per cent. Other tests made 3 hours after irrigation gave a range of from 6 per cent in the surface 6 inches to less than 3 per cent at the 6-foot depth.

The soil gave an acid reaction. The pH, at the beginning of the experiment, averaged about 5.2 in the upper 6-inch layer and 5.3 at a depth of 18 inches.

A complete analysis of a typical soil sample from the upper 6-inch layer, indicated the following content:

Silica	2,350,000 pounds per acre
Potassium	1,750 pounds per acre
Nitrogen	500 pounds per acre
Calcium	156 pounds per acre
Phosphorous	112 pounds per acre
Iron	90 pounds per acre
Titanium	75 pounds per acre

Only 8 to 12 pounds of the potassium was available per acre, however, and merely traces of nitrogen and phosphorous.

Establishment of the Experimental Plots

The trees were divided into eight sample plots, lettered A to H, with five to nine trees to each plot. (Figure 2.) Each group forming a plot was designed to receive a specified treatment. (Table 1.) Care was taken to choose the plots so that the leaching of fertilizer from one plot to another would be unlikely.

Treatment of the Plots

The treatment given the plots is presented in Table 1, with this slight exception: irrigation was omitted when a heavy rain fell on the day scheduled for the watering.

Irrigation Equipment

A gasoline-driven centrifugal pump supplied water as required at about 175 gallons per minute through an iron pipe from which it was distributed to the plots by means of a hose. In the third year, spray piping was installed on three plots and a spray nozzle was also provided for the hose.

Fertilization

Tables 1 and 2 present the principal features in the application of fertilizer. In the latter part of the first season ammonium sulphate was substituted for nitrate of soda because of local commercial conditions.

Soil samples from the fertilized and irrigated plots, taken at intervals during the test, indicated that the benefit derived by this soil from the addition of mineral fertilizers was not lasting. The fertilizers containing nitrate and potassium were quickly carried away by the rain water and the water of irrigation.

Seasons of Springwood and Summerwood Formation

During 1927 and 1928 examination of the development of the current an-

nual growth ring, in one tree on each plot, at intervals of one month or less showed that the springwood portion was formed between the beginning of cambial activity, about March 1, and a varying date in May or June (depending upon seasonal conditions) when the production of summerwood commenced. In 1927 the trees inspected, excepting one, had started formation of summerwood cells by May 10; the exception began about May 20. The spring season of 1927 was characterized by a very low rainfall from the first of March until the latter part of June. In 1928, on the other hand, similar examinations revealed the formation of summerwood by May 22 in only two trees and by June 1 in only half of the trees; in the remaining trees from two to four summerwood cells had been developed by July 3. Summerwood formation, therefore, was under way in all of the trees not much later than June 15, 1928. There was an average difference of about four weeks in the time of the beginning of summerwood formation between the years 1927 and 1928: the early rainfall

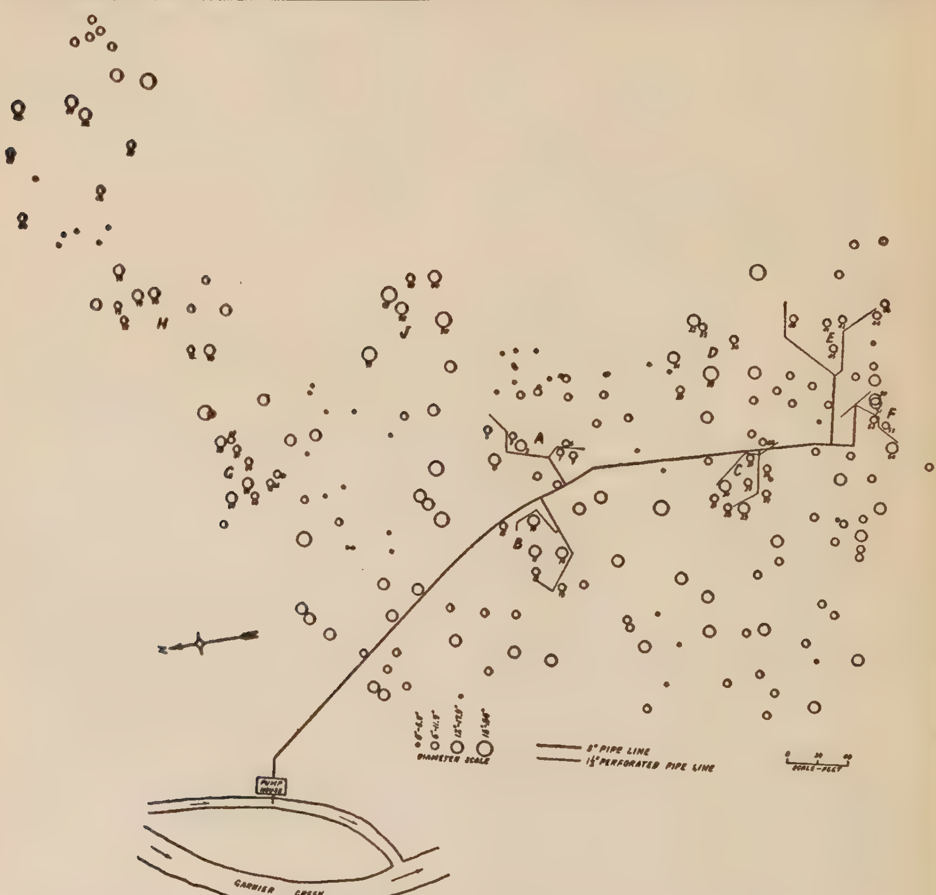

FIG. 2.—Location of experimental plots and of the equipment for irrigation.

TABLE 1.

THE TREATMENT OF THE INDIVIDUAL PLOTS.

Plot	Number of trees	Treatment			
		Fertilizer per tree	Water per plot	Kind	Frequency
		Pounds	*Surface Inches*		
A	7		3 to 4	Irrigation	Twice a week, March to December, 1927, 1928, and 1929.
B	6		3 to 4	Irrigation	Twice a week, March to December, 1927.
			1½ to 2	do	Twice a week, March to December, 1928.
			3 to 4	do	Twice a week, in spray, March to December, 1929.
		5		Nitrate of soda	Every two weeks, March to December, 1927, 1928, and 1929.
		8		Acid phosphate	Every two weeks, March to December, 1927.
		5		Potassium sulphate	do
		3		Acid phosphate	Every two weeks, March to December, 1928.
		3		Potassium sulphate	do
		3		Acid phosphate	Every four weeks, March to December, 1929.
		3		Potassium sulphate	do
C	9		3 to 4	Irrigation	Twice a week, March to December, 1927.
			1½ to 2	do	Twice a week, March to December, 1928.
			3 to 4	do	Twice a week, in spray, March to December, 1929.
		5		Nitrate of soda	Every two weeks, March to December, 1927, 1928, and 1929.
D	6			Check plot	No treatment.
E	6		3 to 4	Irrigation	Twice a week, July to December, 1927, 1928, and 1929.
F	5		3 to 4	Irrigation	Twice a week, March to July, 1927, 1928, and 1929.
G	9	5		Nitrate of soda	Every four weeks, March to December, 1927, 1928, and 1929.
		8		Acid phosphate	Every four weeks, March to December, 1927.
		5		Potassium sulphate	do
		3		Acid phosphate	Every four weeks, March to December, 1928 and 1929.
		3		Potassium sulphate	do
H	7	5		Nitrate of soda	Every four weeks, March to December, 1927, 1928, and 1929.

TABLE 2.

QUANTITY OF FERTILIZER APPLIED TO THE TREES AND THE EXPERIMENTAL PLOTS

			Quantity of fertilizer applied											
			1927			1928			1929			Total for three years		
Plot	Area of plot	Kind of fertilizer	Amount	Rate per tree	Rate per acre	Amount	Rate per tree	Rate per acre	Amount	Rate per tree	Rate per acre	Amount	Rate per tree	Rate per acre
	Acre		*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
B	0.085	Sodium nitrate	240	105	7,411	540	90	6,353	450	75	5,294	1,230	270	19,058
		Ammonium sulphate	390									390		
		Acid phosphate	865	144	10,176	462	77	5,435	144	24	1,694	1,471	245	17,305
		Potassium sulphate	540	90	6,352	450	75	5,294	144	24	1,694	1,134	189	13,341
G	.088	Sodium nitrate	170	51	5,227	405	45	4,602	675	84	7,670	1,250	180	17,500
		Ammonium sulphate	290									290		
		Acid phosphate	748	83	8,500	251	28	2,852	216	27	2,454	1,215	138	13,806
		Potassium sulphate	420	46	4,772	247	27	2.808	216	27	2,454	883	100	10,034
C	.072	Sodium nitrate	360	106	13,264	1,125	125	15,625	675	75	9,375	2,160	306	38,264
		Ammonium sulphate	595									595		
H	.10	Sodium nitrate	130	50	3,550	315	45	3,150	675	96	6,750	1,120	191	13,450
		Ammonium sulphate	225									225		

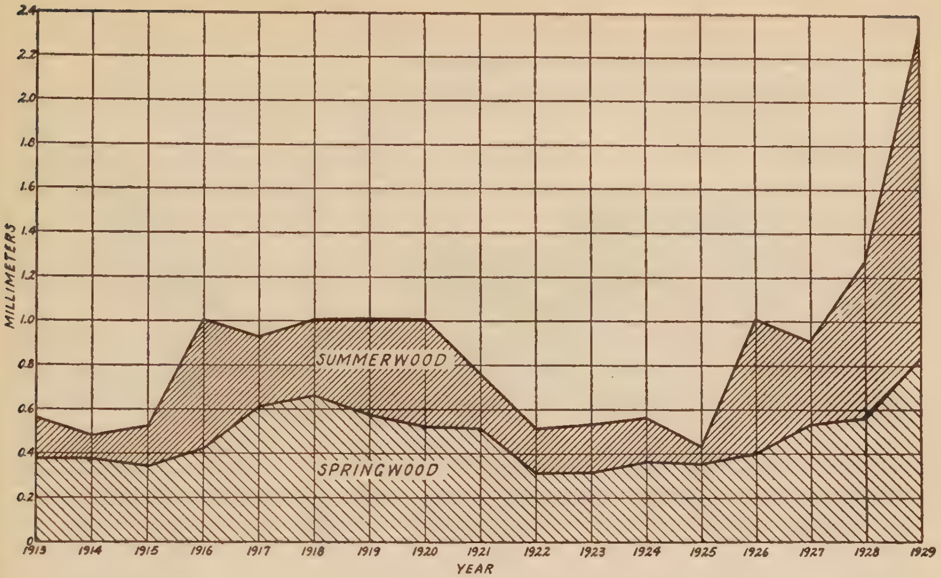

FIG. 3.—The average springwood and summerwood growth of seven trees, Plot A, that received irrigation during the growing seasons of 1927, 1928, and 1929, in comparison with the growth in previous years. The curve shows that the 1927 summerwood growth was somewhat less than the 1926 summerwood growth. This indicates that the irrigation given the trees in 1927 was not so effective in summerwood production as the comparatively heavy natural rainfall of the year 1926.

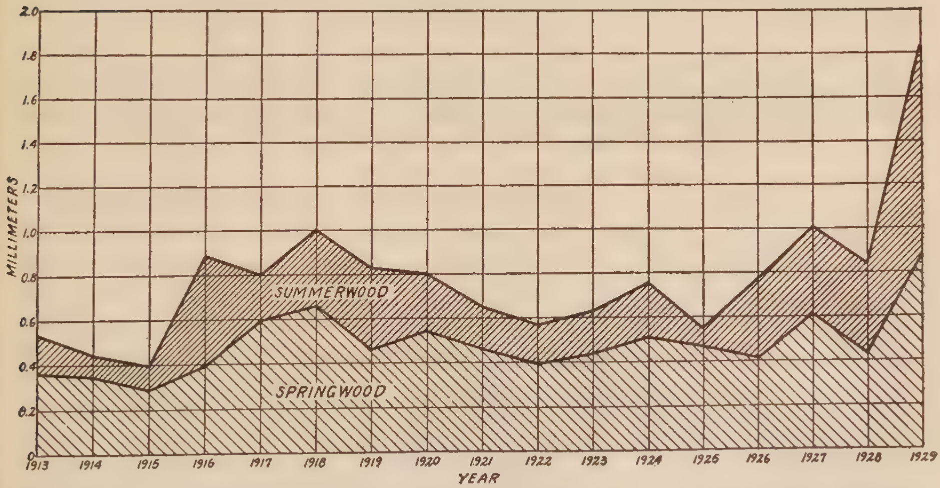

FIG. 4.—The average springwood and summerwood growth of six trees, Plot B, that received irrigation and a complete fertilizer during the growing seasons of 1927, 1928, and 1929, in comparison with the growth in previous years. The dip in the curve for 1928 is explained by the fact that the time of irrigation on this plot was cut in half during the season of 1928 in order to lessen leaching of the fertilizers and run-off of water on the gradually sloping surface of the soil.

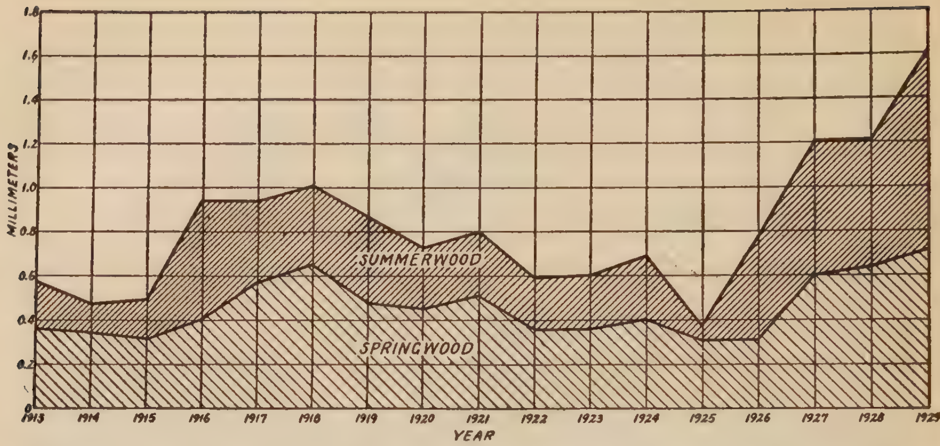

Fig. 5.—The average springwood and summerwood growth of nine trees, Plot C, that received irrigation and a nitrate fertilizer during the growing seasons of 1927, 1928, and 1929, in comparison with the growth in previous years. The irrigation resulted in a complete leaching of the nitrate fertilizer from the upper layers of the soil in less than two weeks after each application.

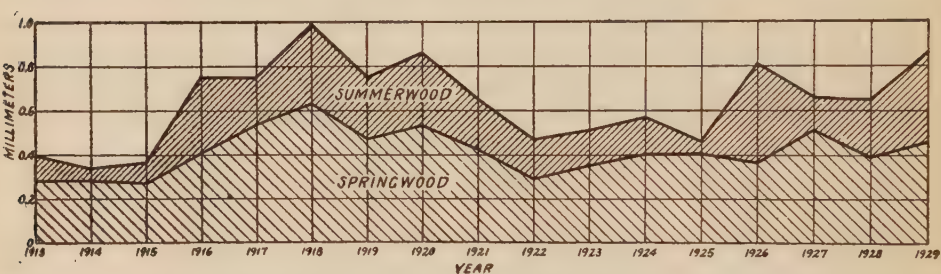

Fig. 6.—The average springwood and summerwood growth of six trees on the untreated Check Plot D, during the growing seasons of 1927, 1928, and 1929, in comparison with the growth in previous years. The natural precipitation for 1929 was the highest on record since weather bureau records were begun at the Camp Pinchot Ranger's Station in 1913.

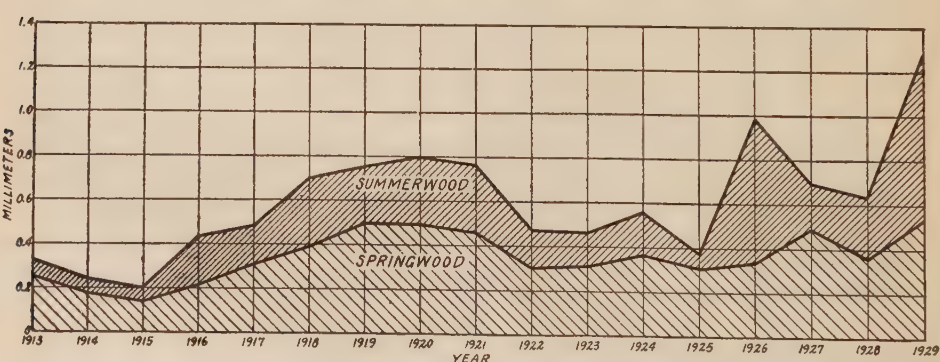

Fig. 7.—The average springwood and summerwood growth of six trees, Plot E, that received irrigation from July 1 to November in the years 1927, 1928, and 1929, in comparison with the growth in previous years.

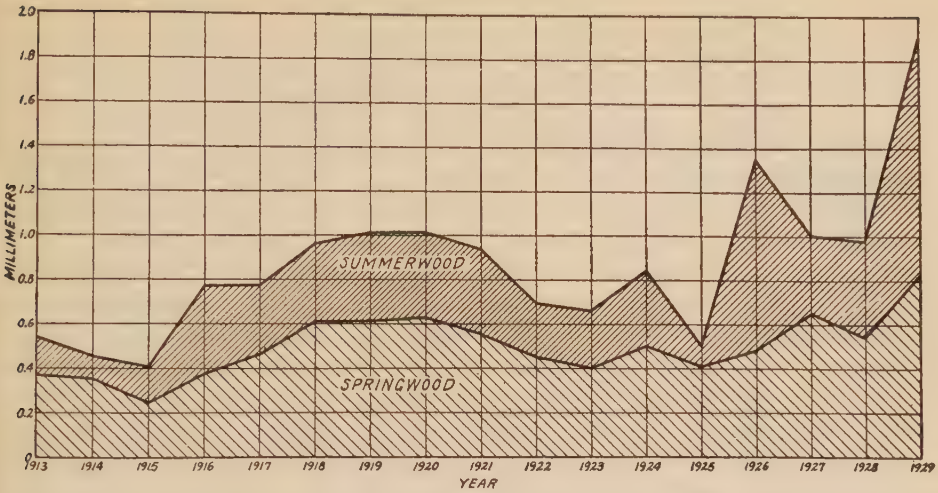

FIG. 8.—The average springwood and summerwood growth of five trees, Plot F, that received irrigation from March to June 30 during the years 1927, 1928, and 1929, in comparison with the growth in previous years.

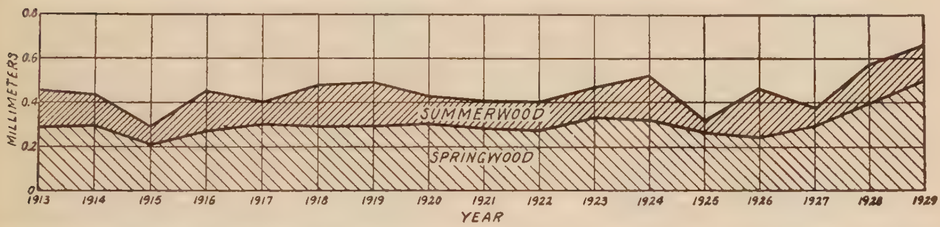

FIG. 9.—The average springwood and summerwood growth of seven trees, Plot G, that received a complete fertilizer but no irrigation during the years 1927, 1928, and 1929, in comparison with the growth in previous years.

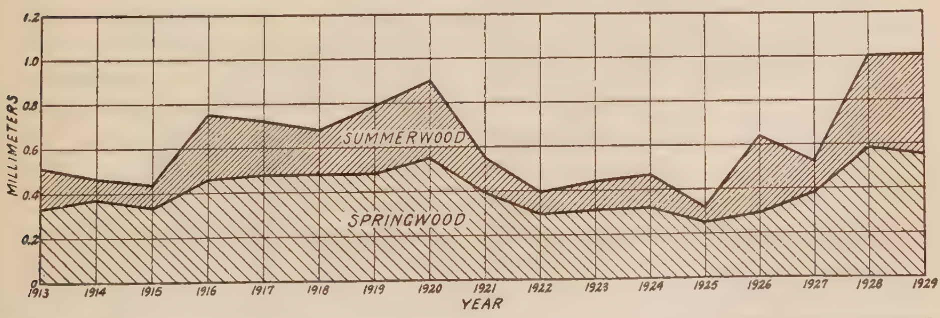

FIG. 10.—The average springwood and summerwood growth of seven trees, Plot H, that received a nitrate fertilizer but no irrigation during the years 1927, 1928, and 1929, in comparison with the growth in previous years.

in the second year was more than twice that in the first, and was reasonably well distributed in time of occurrence. Summerwood production continued, when conditions were favorable, until late in the autumn; the growth of the ring was still incomplete in a portion of the trees on December 10, 1929.

Effect of Treatment Upon Ground Vegetation

The heavy applications of sodium nitrate resulted in some scalding of the grass and herbaceous vegetation, especially in Plots C and H. (Table 1.) In Plots B and G, on the other hand, the combination of irrigation and complete fertilizer greatly stimulated the growth of the herbaceous vegetation and shrubs. On the lower sides of and just below B and G, the grass formed a thick and rank cover even during the first season. Among the shrubs present, the sumach (*Rhus sp.*) and the oak sprouts (*Quercus sp.*) grew to much greater size than similar plants in the vicinity.

Effect of Treatment Upon the Longleaf Pine

Foliage. All of the trees on the plots that received treatment of any kind throughout the season gave conclusive visible evidence of that fact before the end of the first season; the needles were longer and darker than those of surrounding trees. The most conspicuous response to treatment was shown by the trees on Plot C which received water and nitrate fertilizer; the needles of these trees elongated sufficiently to curve outward and form the typical umbrella-like clusters of longleaf pine while the new needles on the untreated trees were still in compact brushlike clusters only from 1 to 2 inches long.

Closely similar were the trees on the plot given irrigation and a complete fertilizer, and these were followed by the trees on the plots that received water only. The shedding of the old needles began earlier and progressed at a more rapid rate on the plots without fertilizer than on the fertilized ones, although not all of the old needles dropped off. The trees on the check plot and on the one that received no treatment up to July, showed no improvement over the rest of the forest. The unirrigated but fertilized plots were in slightly better condition than the other forest trees in the retention of old needles, but showed little advance in new growth.

With the rains in June and July, 1927, the needles of the untreated forest trees resumed growth as did also those of the trees on the unirrigated fertilized plots; the treated trees, however, made a better showing, so that at the end of the growing season the large, massive clusters of their needles were from one and one-half to two and one-half times as long as the others.

During 1928 and 1929, on account of greater amounts and a more even distribution of rainfall than that which occurred in 1927, the external differences in the appearance of the foliage of the treated and the untreated trees were less conspicuous.

Seed production. In addition to the changed appearance of the foliage the application of fertilizer had also a noticeable effect upon the seed production of the trees on the different plots.

TABLE 3

AVERAGE INCREASE IN THE SPRINGWOOD PORTION, THE SUMMERWOOD PORTION, AND THE TOTAL WIDTH OF THE ANNUAL GROWTH RING OF IRRIGATED, FERTILIZED, AND CHECK PLOTS OF LONGLEAF PINE TREES DURING THREE YEARS OF TREATMENT, 1927 TO 1929, INCLUSIVE, IN COMPARISON WITH THE AVERAGE GROWTH DURING THE 14 YEARS PREVIOUS TO 1927.

Plot	Number of trees	Treatment	Percentage increase or decrease (—) in growth		
			Springwood	Summerwood	Total ring width
A	7	Irrigation only March to December	45.4	165.9	96.5
B	6	Irrigation plus complete fertilizer	42.0	136.6	74.5
C	9	Irrigation plus nitrate fertilizer	57.7	131.6	88.6
D	6	Check plot, no treatment	12.9	24.3	16.8
E	6	Irrigation only, July to December	40.0	94.6	61.5
F	5	Irrigation only, March to July	45.1	89.9	63.9
G	7	Complete fertilizer, no irrigation	40.4	—8.9	23.5
H	7	Nitrate fertilizer, no irrigation	31.6	86.8	50.1

The year 1929 was the first since the establishment of the experiment that the longleaf pine trees of the Choctawhatchee National Forest have borne seed. Although this year was not considered a heavy seed year many trees throughout the forest produced a crop of cones. On the experimental area the greatest production of cones was found on trees in the fertilized plots. Since it requires 2 years for longleaf pine cones to mature, the treatment given the trees in 1927 and early in 1928 probably affected the seed bearing. No inverse relation between the seed production and the width of the annual rings of the trees in these plots was found.[4]

Wood formation. At the end of three seasons of treatment (December, 1929), chips or increment borings including the last 17 annual growth rings were taken from all of the trees on the plots. This material was examined under the microscope and the thickness of the springwood, the summerwood, and the entire annual ring was measured for each year and for each tree. The average radial growth of the trees on each plot for the 14 years before and the 3 years of treatment are presented in the graphs of Figures 3 to 10, inclusive. Table 3 compares the average percentage increase in the springwood portion, the summerwood portion, and the total ring growth during the treatment and before it.

CONCLUSIONS

The results of this investigation justify the conclusion that a fairly close correlation exists between the current soil water supply and the formation of summerwood in longleaf pine trees in the deep, sandy soils of the Choctawhatchee National Forest. Such a correlation is evidenced in general by a comparison of the width of the summerwood portion of the annual growth ring and the amount of precipitation during the season of growth, over a period of several years. It is greatly emphasized by the results of a systematic irrigation of

[4]Lodewick, J. Elton. Effect of Certain Climatic Factors on the Diameter Growth of Longleaf Pine in Western Florida. Jour. Agr. Research 41, 349-363. 1930.

the trees, throughout the season of growth, for three years. This fact supports previous statements[5] based upon the examination of trees that had been growing under different conditions of environment.

The application of a complete fertilizer, without water other than the natural precipitation, appeared to increase the rate of growth of the trees in diameter to a slight degree, although more in the springwood portion of the annual growth ring than in the summerwood portion. A nitrate fertilizer, without irrigation, also increased the total growth but increased the summerwood to the greater degree. In both cases it is likely that the abundant supply of available soil moisture in 1928 and 1929 had as great an effect upon the growth of the trees as the fertilizers. A count of the cones borne by the trees on the plots in 1929 indicates that cone production was stimulated by the treatment given, especially on the fertilized plots.

Although irrigation of the southern yellow pine forests can not be recommended as practicable, the results of the experiments described here indicate some silvicultural measures that may prove beneficial in the management of such forests. The maintenance of forest soil conditions that will promote the retention of moisture, making it continually available to the trees, will result not only in a greater growth increment but also in the production of heavier and stronger wood than that obtained under less favorable conditions of soil moisture. In the southern pine region it is not a matter of conserving a limited water supply but rather of holding some of the rainfall, which usually is abundant in total amount. The exclusion of forest fires, a satisfactory stocking of the forest areas, and an admixture of broad-leaved species with the conifers are all silvicultural measures that would increase the organic content of the soil, the soil fertility, and the capacity of the soil for the retention of water.

ANATOMICAL STUDIES OF THE WOOD OF A HYBRID LARCH[1]

By KAFILUDDIN A. CHOWDHURY[2]

With several organizations actively interested in hybridizing forest trees it becomes of interest to know what changes are brought about in the wood of the hybrid. In this case a natural hybrid was investigated as to the anatomical structure of its wood. A study on a limited scale of eleven characteristics indicates that in this case the hybrid has a wood structure more nearly resembling that of the female parent.

NATURAL hybridization in the plant world has long been recognized but the principles underlying its effect on the resulting offspring were not known until the time of Mendel. During the last thirty years, many workers have been interested in these "crosses", especially those of herbaceous species, but their work has been largely confined to external morphology or at best to the histology and cytology of the primary tissues of leaves, young parts, and the like; in fact, most investigators have purposely avoided working with woody plants and more especially trees, largely because of the time element involved in the maturation of the offspring. This has resulted in a dearth of information as to where and to what extent the blending of characters takes place in woody hybrids, especially in the secondary tissues.

Material

In pioneer studies of this type, it is obvious that the plants which best afford opportunities for investigation are those in which the organization of the secondary tissues is of the simplest sort. outset would facilitate research in this field not only because of the restricted number of cell types involved but also It follows that selection of these at the because of the concomitantly limited number of permutations which must be considered. The Gymnosperms, owing to their simple anatomy and general freedom from uncontrolled hybridization, fulfill these requirements, and hence a gymnospermous hybrid has been selected for the present study.

The author was fortunate in obtaining material of the Dunkeld hybrid larch, *Larix eurolepis* Henry, and of the parents *L. europaea* DC. and *L. leptolepis*, Hort., all from Dunkeld, Scotland. Since the specimens were not preserved in liquid, it has not been possible to include data upon the delicate tissues of the secondary phloem; in consequence the study has been confined to an analysis of those changes which appear to have taken place in the secondary xlyem as a result of hybridization.

Review of Literature

A survey of the literature upon hybridization among the conifers shows that in nature, "crosses" are by no

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means common (9), since only a few authentic cases are cited, among which the following may be mentioned, *Tsuga mertensiana* Sarg. × *Tsuga heterophylla* Sarg. = *Tsuga Jeffreyi* Henry; *Larix laricina* K. Koch × *Larix decidua* Mill. = *Larix pendula*, Salisb.; *Larix europaea* DC. × *Larix leptolepis* Hort. = *Larix eurolepis* Henry.

In 1845 Klotzsch (6) started work upon hybridization of trees by crossing two species of each of the following: pine (*Pinus*); oak (*Quercus*); alder (*Alnus*); elm (*Ulmus*); in all instances he noticed an increased vigor in the growth of the hybrid progeny but unfortunately this work was not continued and consequently very little information concerning these hybrids is available. More recently, the question of hybridizing trees has again come to the fore, largely as the result of the achievements of the horticulturist and agriculturist in their respective fields, and the ever pressing need for the best possible stock for reforestation. Among the interesting contributions in tree hybridization, that, dealing with the Dunkeld hybrid by Professor Henry and Miss Flood (9), should be mentioned. This paper records interesting data obtained from a study of characters visible to the naked eye in addition to those compiled from a cursory examination of such structures as the resin canals in the young twigs, and resin canals, fibrovascular bundles, epidermal cells and stomates in the leaves. The subsequent papers by Henry (10) (11) on the artificial production of vigorous trees and the art of producing more rapidly growing trees as a result of hybridization are of timely interest to foresters since they are indicative of the difficulties which may be encountered in the artificial crossing of trees. In this connection, the work of Janssonius and Moll (13) deserves mention, even though it is not strictly pertinent to the subject in question. As indicated by the title, "Der anatomische Bau des Holzes der Pfropfhybride *Cytisus adami* und ihrer Komponente", this research consisted of a comparative anatomical study of the wood of a "graft" as compared to the normal wood of the two parents; the results indicated that the xylem of the "scion-hybrid" resembled more closely that of *C. laburnum*, the "stock" parent.

History of the Dunkeld Larch Hybrid

At Dunkeld (Perthshire), Scotland, ten trees of *L. leptolepis* are now growing which were raised from seeds imported from Japan in 1884 (9). A number of specimens of *L. europaea* occupy a nearby hillside. The seedlings from these Japanese larches were observed to depart materially in their external characters from those normally grown elsewhere. They were of different habit and exhibited much greater vigor, and subsequent investigation proved that they had resulted from cross-fertilization by the pollen of *L. europaea*. The natural hybridization of these two species had previously been observed by foresters who had taken advantage of it to obtain seedlings which would prove especially resistant to the widespread larch canker. Some of these hybrid trees have since arrived at maturity and their habit and botani-

cal characteristics conform to the Mendelian theory of segregation. Artificial cross-pollination has also been attempted between these species but for some unaccountable reason it was unsuccessful.

Nature and Method of Study

Since a group of workers have shown that a change in the ecological conditions under which a plant grows may bring about a modification of its internal structure (7), it seemed desirable to obtain wood specimens from neighboring trees of approximately the same age and on the same site. The source of the material of the Japanese larch and the Dunkeld hybrid was from the above mentioned trees at Dunkeld, but owing to the fact that larch is wind pollinated, the individual identity of the male parent could not be ascertained. Scientific accuracy was at least approximated, however, in that the specimens for the xylem study of the male parent were collected from a nearby stand

In order to determine the degree of variation which appears in the xylem of the parent species under varying conditions and in different countries, wood samples of *L. europaea* from Wales, Ireland, Scotland, France, Sweden, Italy and New Hampshire (U.S.A.) and of *L. leptolepis* from Japan and Scotland were examined. It is inadvisable at this point to go into detail as to the minor anatomical variations in these woods; it is sufficient to state that the European larch, irrespective of its origin and condition of growth, possesses certain diagnostic features in the xylem, which readily permit of its separation from "Scottish-grown" *L. leptolepis* although not necessarily from this species growing normally in Japan. That this assumption is based upon an examination of relatively few specimens and in consequence may be contradicted by a more searching investigation, is fully realized. Furthermore, mention of the fact should be made that the Japanese larch grown in Japan and the same species grown in Scotland show a decided difference in structure for which reason this study has been confined to an examination of the material at Dunkeld and its immediate vicinity. In this way, and in this way only, has it been possible to reduce the geographical and site variations to a minimum.

Discussion and Deductions

As is shown in Table 1, the maximum radial and tangential diameters of the longitudinal resin canals of *L. europaea* are 130 and 100 microns respectively, while those of the *L. leptolepis* measure 46 and 57 microns. This represents a considerable inter-species difference. The canals of the hybrid *L. eurolepis*, by comparison, exhibit a maximum radial width of 95 microns and a maximum tangential width of 90 microns, that is, measurements which approach nearest to those of *L. europaea.* Thus it would appear from this evidence at least that the factor which determines the maximum diameter of longitudinal resin canals of *L. europaea* is dominant in the hybrid.

A comparable condition might naturally be anticipated in respect to the measurements of the horizontal resin canals but actually it does not occur.

TABLE I

TABLE SHOWING THE MEASUREMENT OF MICROSCOPICAL STRUCTURES*

Species	Resin Canal				Rays					Tracheid		
	Longitudinal		Horizontal		Fusiform		Linear			Length in Microns		Diam. in Microns
	Radial Diameter	Tangential Diameter	Height	Width	Height	Width	Seration	Height in cells	Height in feet	Minimum	Maximum	And thickness of wall (—)
Larix leptolepis—	30-46	30-57	27-38	19-28	119-335	38-46	1-2	14-18	300-400	500	3,400	27-35 (2-6)
Larix europaea—	53-130	57-100	57-110	30-57	300-670	38-68	1	32-42	750-900	1,000	5,000	40-50 (2-10)
Larix eurolepis—	34-95	27-90	27-44	15-21	185-385	22-30	1	16-20	335-400	900	4,000	30-38 (2-7)

**All measurements are in microns.*

In this instance the vertical and horizontal diameters of the European larch were 110 and 57 microns respectively as compared to the measurements of 38 and 28 for the Japanese larch while in the hybrid these canals exhibit comparable widths of 44 and 21 microns. This means that the hybrid has not inherited its horizontal canal-size from *L. europaea* as in the case of longitudinal type but retains the dimensions of the canals of *L. leptolepis*. Thus in the hybrid, the longitudinal canals approach in size those of the one parent and the horizontal canals those of the other.

Moreover, in regard to both the linear and the fusiform rays, the hybrid exhibits the same dimensional limits as *L. leptolepis*.

Since the hybrid reveals so great an intermingling of the parental characters, in which it favors the staminate parent in some respects, the ovulate in others,

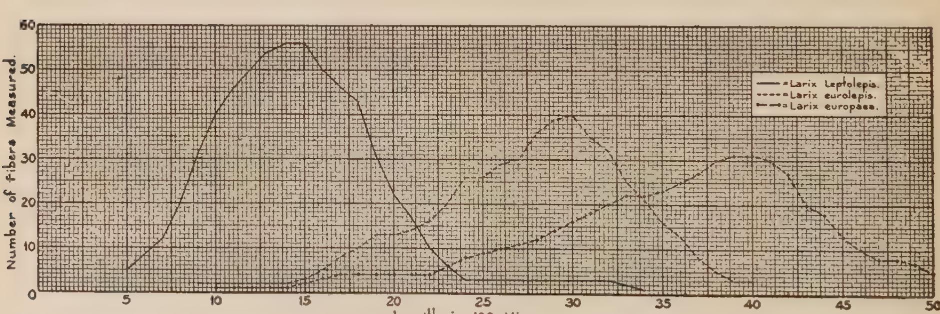

FIG. 1.—Comparative numerical distribution of the fibers in respect to length, measured at random.

and occupies an intermediate position in still others, it was thought advisable to study the fiber lengths of the three species more critically, but before going into a detailed discussion of this phase of the problem it may not be out of place to introduce a brief statement regarding the method of "sampling" employed in obtaining the data for Table 1 and Figures 1 and 2. Table 1 includes the length classes of both the springwood and summerwood fibers for the three species. The materials for this study were obtained as follows: (1) samples including both the summerwood and springwood were macerated by using Schultze's method; (2) the fibers were measured at random without attention to whether or not they came from the springwood or summerwood, or in what proportion each type was taken; (3) three curves (Figure 1) were drawn to show the comparative numerical distribution of the fibers of each species in respect to length; (4) the percentage of springwood and summerwood fibers were computed from cross sections of the normal wood and the results indicated that each type was present in practically equal numbers; (5) samples of the springwood and the summerwood were also macerated separately and equal numbers of fibers were measured at random; (6) the two groups of data were added to give the sum total of the springwood and the summerwood fibers for Figure 2.

A careful examination of Figures 1 and 2 reveals the fact that the individual modes for the three species do not coincide in the two sets of graphs, as indicated by the relative position of the highest points on the curves. For example, in Figure 1 the modes are approximately at 1,500 microns for *L. leptolepis*, at 3,000 microns for *L. eurolepis* and at 4,000 microns for *L. europaea;* while in Figure 2 they are at approximately 2,000, 2,000 and 4,000 microns respectively. Furthermore in Figure 1, *L. eurolepis* takes an intermediate position between *L. leptolepis* and *L. europaea*, while in Figure 2 the curves for *L. leptolepis* and *L. eurolepis* more or less coincide while that for *L. europaea* takes an altogether different shape and position. It might be noted in passing that the form of the curves for *L. europaea* has not been appreciably altered by the two different methods of sampling.

As regards the accuracy and the reliability of the two methods followed in obtaining the data for Figures 1 and 2, it would appear that one might run into considerable danger in taking samples of macerated fibers including both springwood and summerwood. Obviously the measurement of too many fibers of one type and too few of the other would give results wholly at variance to those which should be obtained when the proportion of springwood and summerwood tracheids in the ring was considered. This defect in taking samples may totally upset the proportions in which such cells occur in the growth ring. Thus the mode and the general contour of graphs plotted from such data may be altered to such a degree that any correlations which might exist may not be apparent, or erroneous conclusions might be drawn. For this reason the data from which the Figure 1 was plotted have been discarded in favor of the one in which the springwood and the summerwood fibers were measured separately in their proper proportions.

While measuring the tracheids of *L.*

eurolepis it was observed that most of those which were over 3,400 or more microns long came from the summerwood, a cell type which could be easily distinguished by its thick wall and narrow lumen. This naturally suggests a question as to whether or not the gain in the general length of the tracheids of the hybrid larch was restricted to the outer part of the ring. In order to answer this question splinters of springwood and summerwood were macerated separately and over 300 tracheids from each type in each of the three species were measured, and their maximum and minimum lengths were recorded as indicated in Table 2.

A study of this table indicates certain facts and relationships in regard to the limits of the fiber lengths of the springwood and summerwood tracheids which are characteristic of the parents and their offspring and which may be summarized as follows:

TABLE 2.

MINIMUM AND MAXIMUM LENGTH OF TRACHEIDS

Species	Spring tracheid length Shortest	Longest	Summer tracheid length Shortest	Longest
	All measurements are in microns			
L. leptolepis	500	2,500	1,400	3,400
L. europaea	1,000	4,500	1,700	5,000
L. eurolepis	900	2,600	900	4,000

A. In regard to minimum lengths:

1. The springwood tracheids of the hybrid, *L. eurolepis,* presents a minimum which is more or less intermediary between those of the two parents, but since it tends to approach that of the staminate, *L. europaea,* it may be suggestive of dominance in this respect.

2. The summerwood tracheids of the hybrid are shorter than are those of either parent, and since the male parent *L. leptolepis* has the shorter fibers, it may be argued that it is indicative of a dominance in the other direction.

3. The hybrid shows the same minima in the springwood and summerwood tracheids in spite of the fact that the shortest summerwood fibers of both parents are longer than are their corresponding springwood tracheids.

B. In regard to maximum fiber lengths:

1. The springwood tracheids of *L. eurolepis* tend to approach those of the ovulate parent, *L. leptolepis.*

2. The summerwood tracheids of the hybrid show a similar but less pronounced trend, but nevertheless, one which is sufficient to warrant the suggestion that in both the fiber series the maximum length characteristic of *L. leptolepis* tends to be dominant in the hybrid, a relationship which is diametrically opposite to that found to prevail in regard to the minimum length of the springwood tracheids.

As the conclusions derived from the study of the limits of the fiber lengths in the three species were found to be inadequate, an attempt was made to analyze the data by statistical methods. This was done by calculating the lower and upper quartile measures from isolated springwood and summerwood fibers from each species. Table 3 shows that for the springwood fibers the hybrid has an l. q. limit of 1,490 microns and

an u. q. limit of 2,020 microns, the Japanese larch 1,540 microns and 2,030 microns, and the European larch 2,375 microns and 3,559 microns respectively. In the summerwood fibers the l. q. and u. q. limits for the hybrid were 2,256 microns and 2,970 microns, for the Japanese larch 2,113 microns and 2,730 microns, and for the European larch 2,875 microns and 4,207 microns respectively. This means that in the distribution of the fiber length classes the hybrid shows a decided affinity for the mother parent, as revealed by the values recorded in Table 3.

In the diameter of the tracheids and the thickness of their walls, Table 1 shows that the hybrid again occupies an intermediate position.

The presence or absence of spiral thickenings on the wall of the tracheids is important in this connection. Kanehira (13) in discussing the structure of *L. leptolepis* says that "spirals sometimes may occur in the wall of the earlywood tracheid". Then in a subsequent publication (14) he gives a drawing showing the presence of the spirals in the ray tracheids. On the other hand, when describing the same wood, Fujioka (8) says, "die Spiralverdickung der Tracheiden nur auf dem Spätholz sich nachweisen lässt, doch bei dem Vorhandensein der spiralegen Streifung fehlt; ferner zeight die Quertracheide niemals Spiralbildung". In spite of the fact that the above statements are contradictory, both have been found to be true. The writer found spiral thickenings in only one longitudinal tracheid of *L. leptolepis* during an examination of a number of tangential and radial sections, and moreover that tracheid was situated adjacent to a longitudinal resin canal. In addition, the presence of spirals in a ray tracheid contiguous to a longitudinal resin canal was also detected. Thus both the above statements were found to be correct, but it must be assumed that the occurrence of spiral thickenings is extremely rare and possibly found only in association with longitudinal resin canals. No true spirals were observed on the walls of the tracheids of either *L. europaea* or *L. eurolepis*.

It may be interesting to note in this connection that a peculiar type of closely spaced striations were found on the walls of the summerwood tracheids of *L. leptolepis* and *L. eurolepis*, but not on the walls of the tracheids of *L. europaea*.

Table 4 summarizes the position of the anatomical structures of the wood of the hybrid larch in relation to the same features as they appear in the wood of the parents.

An examination of Table 4 shows that out of eleven characters the hybrid favors the European larch in only one case, it holds an intermediate position in but three, and in all of the remainder it stimulates the features of the Japanese

TABLE 3.

LOWER AND UPPER QUARTILES OF TRACHEID LENGHTHS

Species	Springwood tracheids Lower quartile	Springwood tracheids Upper quartile	Summerwood tracheids Lower quartile	Summerwood tracheids Upper quartile
	All measurements are in microns			
Larix leptolepis	1,540	2,030	2,113	2,730
Larix europaea	2,375	3,559	2,875	4,207
Larix eurolepis	1,490	2,020	2,256	2,970

larch. Hence it would appear that the structure of the wood of the hybrid larch, *L. eurolepis*, does not occupy an intermediate position between the producing species but rather one which tends to approach that of the ovulate parent and to that degree at least it may be classified as dominant on the distaff side.

Summary

1. The longitudinal resin canals of the Scottish-grown larch hybrid, *L. eurolepis*, attain the cross-dimensional limit of those of the male parent, *L. europaea;* the horizontal canals in contrast approach closely in size those of the female parent, *L. leptolepis*.

2. The length, diameter, and wall thickness of the tracheids of the hybrid are intermediate between those of the parent species.

3. The increase in length of the tracheids of the hybrid as compared to those of the female parent, *L. leptolepis*, is restricted to those of the summerwood type.

4. The characteristic striations found on the wall of the Japanese larch appear to have been inherited by the hybrid.

5. The most reliable method for "sampling" the wood fibers of larch, and possibly of conifers in general, consists in macerating the springwood and summerwood sperately in order that the proportions in which these cells occur in the growth ring may be retained in the subsequent data.

Acknowledgments

Acknowledgments are due to Professor W. W. Smith of Edinburgh University and to the Keeper of Scottish Royal Botanic Garden, Edinburgh, for supplying authentic materials from Dunkeld. The writer is also indebted to Professor F. S. Page of Dartmouth College for some material and to Professor C. C. Carpenter of Syracuse University for his help in the statistical part of this thesis. Lastly, the writer wishes to express his high appreciation to Drs. H. P. Brown and C. C. Forsaith, of the Department of Wood Technology, New York State College of Forestry, Syracuse, N. Y., for their invaluable advice and criticism throughout this work.

Table 4.

COMPARISON OF ANATOMICAL STRUCTURE BETWEEN HYBRID AND PARENTS

Characters of the hybrid	Name of the parent which the hybrid favors, or intermediate position between the parents
1. Resin canals, longitudinal	*L. europaea*
2. Resin canals, horizontal	*L. leptolepis*
3. Rays, fusiform	*L. leptolepis*
4. Rays, linear	*L. leptolepis*
5. Tracheid length: springwood	*L. leptolepis*
6. Tracheid length: summerwood	Intermediate
7. Frequency curves of the mixture of springwood and summerwood tracheids	*L. leptolepis*
8. Upper quartile and lower quartile of isolated springwood and summerwood tracheids	*L. leptolepis*
9. Tangential diameter of tracheids	Intermediate
10. Thickness of the walls of tracheids	Intermediate
11. Striations on the walls of tracheids	*L. leptolepis*

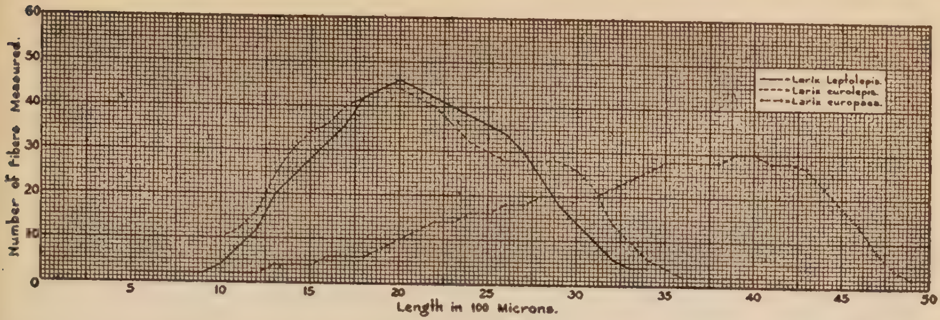

FIG. 2.—Comparative numerical distribution of the fibers in respect to length, springwood and summerwood fibers measured separately and totaled.

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A PLANIMETER CHART

By RALPH R. HILL

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Many foresters frequently use the planimeter for determining the areas of irregular figures. The author has computed a table for rapidly converting planimeter readings to acres for maps drawn to various scales.

THE PLANIMETER is a convenient instrument, extensively used by foresters, for determining the area of irregular figures, but its use, for any long period of time, becomes exceedingly tiresome.

As a result of several weeks of continuous use of the planimeter a chart was prepared for converting planimeter readings to acreage. Its use shortens the work by two steps. The necessity for computing the converting factors for the more commonly used map scales is eliminated, and, instead of multiplying the planimeter reading by the converting factor, the chart substitutes a shorter step of addition in which there is less chance for arithmetical error. Factors for scales of 4 and 8 inches to the mile are simple figures, easily applied without a chart, but scales such as found on U. S. Geological Survey quadrangles, 1:125,000, require considerable computation which can be done away with by using the chart.

Example: The full planimeter reading including vernier is 5328 (53.28 square inches) for a definite area on a 2 inch=1 mile map. Reading from the chart along the line for this map scale at the bottom of this page.

Example: For the same planimeter reading on a map drawn to a scale of 1:125,000 (1″=10,417 feet) the area would be:

5000 units=	124549 acres,
300 units=	7473 acres,
20 units=	498 acres,
8 units=	199 acres,
5328 units=	132719 acres.

The map scales given on the chart are those more frequently used, but values for additional scales may be computed and added as desired. For accurate work the map should be to scale and the instrument in adjustment.

Suggestions for Operating a Polar Planimeter

1. Whenever possible, set the instrument so that a line from the tracing point to the graduated wheel is directly away from the operator when in position for the initial reading. Then it will not be necessary to move around the map or to read an inverted instrument.

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5 units of the vernier=8.0 acres, or 5000 units=8000 acres
3 units of the vernier=4.8 acres, or 300 units= 480 acres
2 units of the vernier=3.2 acres, or 20 units= 32 acres
and 8 units= 13 acres

and the total acreage for the reading is 8525 acres

TABLE 1

PLANIMETER CHART SHOWING VALUE IN ACRES OF MULTIPLES OF VERNIER UNIT FOR VARIOUS MAP SCALES

(For planimeters with a vernier unit of 0.01 square inches)

	Vernier								
Scale of map	1	2	3	4	5	6	7	8	9
¼ in.=1 mi.	102.4	204.8	307.2	409.6	512.0	614.4	716.8	819.2	912.6
½ in.=1 mi.	25.6	51.2	76.8	102.4	128.0	153.6	179.2	204.8	230.4
1 in.=1 mi.	6.4	12.8	19.2	25.6	32.0	38.4	44.8	51.2	57.6
2 in.=1 mi.	1.6	3.2	4.8	6.4	8.0	9.6	11.2	12.8	14.4
4 in.=1 mi	.4	.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6
8 in.=1 mi.	.1	.2	.3	.4	.5	.6	.7	.8	.9
16 in.=1 mi.	.025	.050	.075	.100	.125	.150	.175	.200	.225
1 in.= 50 ft.	.0006	.0012	.0017	.0023	.0029	.0034	.0040	.0046	.0052
1 in.=100 ft.	.0023	.0046	.0069	.0092	.0115	.0138	.0161	.0184	.0207
1 in.=200 ft.	.0092	.0184	.0276	.0367	.0459	.0551	.0643	.0735	.0826
1 in.=300 ft.	.0207	.0413	.0620	.0826	.1033	.1240	.1446	.1653	.1860
1 in.=400 ft.	.0367	.0735	.1102	.1469	.1837	.2204	.2571	.2939	.3306
1 in.=500 ft.	.0574	.1148	.1722	.2296	.2870	.3444	.4017	.4591	.5165
1 in.=1000 ft.	.2296	.4591	.6887	.9183	1.1478	1.3774	1.6070	1.8366	2.0661
1:24000 or 1 in.=2000 ft.	.9183	1.8366	2.7548	3.6731	4.5914	5.5096	6.4279	7.3462	8.2645
1:48000 or 1 in.=4000 ft.	3.673	7.346	11.019	14.692	18.366	22.039	25.712	29.385	33.058
1:62500 or 1 in.=5208 ft.	6.227	12.455	18.682	24.910	31.137	37.365	43.592	49.820	56.047
1:125000 or 1 in.=10417ft.	24.910	49.819	74.729	99.639	124.549	149.459	174.368	199.278	224.188

2. In planimetering adjacent areas it is often possible to make the initial reading at a point common to two or more areas. The final reading of the first area may then be used as the initial reading for the adjoining area.

3. Make a rough preliminary excursion around the figure to see that the entire boundary can be reached with the wheel remaining on the paper.

4. Mark the starting point and follow the circumference clockwise.

5. It is not necessary to set the instrument at zero, it is easier to subtract the initial reading from the second.

6. It is desirable to make two readings and average them for the final result. The practice of checking one clockwise circuit by returning the tracing pointer counter-clockwise to the initial point may check the accuracy with which the circumference was followed, but does not check an error in reading the instrument.

7. A reading glass or a low-power hand lens simplifies reading the vernier.

8. When planimetering large areas it is necessary to set the fixed point of the instrument (pole) within the area. To this reading must be added the constant figure stamped on the arm of the instrument. The constant is the area of a circle described when the arms of the instrument are in the position that the angle formed by the fixed point wheel tracing point is 90 degrees, and in following this circle the graduated wheel does not turn (zero circumference). If the area planimetered is smaller than the area of the zero circumference, the reading will be negative and must be subtracted from the constant.

BRIEFER ARTICLES AND NOTES

Fire-Weather Projects in Retrospect and Prospect

Much progress has been made in recent years in the study and solution of fire-weather problems. Such progress has been largely the result of expanded organization, increased personnel, improved communications and more adequate mechanical equipment. The relation between weather conditions and difficult fire situations has always been recognized by those engaged in fire-suppression, but the recognition found its first definite expression in 1913 when the U. S. Weather Bureau undertook to issue fire-weather forecasts through its Portland (Oregon) office for the information and guidance of suppression forces in Oregon and Washington. Since that time fire-weather forecasting has become a regularly established function of the Weather Bureau throughout the far western states, and has extended its usefulness to certain regions east of the Rockies as well.

In its development from very small beginnings in 1913 the fire-weather service has demonstrated the effectiveness of the same principles that have demanded recognition in other branches of applied meteorology such as the frost warning service and airway weather service. These principles may be summed up in the one word "localization." Localization connotes the ability to apply general meterological information to restricted areas and special topographic situations. It is indispensable to the proper performance of Weather Bureau duties in the Far West—a fact which may be accounted for by the peculiarities of western topography. The West is conspicuously a mountainous region, and mountain climates are notoriously individual. The vagaries of mountain weather are too well known to require review, and the necessity of understanding them in organized attempts at fire suppression is obvious.

The atmospheric ocean is homogeneous, and viewed as a whole its analysis by a single forecaster supplied with information such as that accumulated twice daily at district forecast centers is feasible; he can generalize with comparative assurance as to its present characteristics and probable future changes over the wide areas. But ordinarily he can generalize only. Progress in fire-weather forecasting, as in frost forecasting or airway weather forecasting, resides not alone in the improvement of a general synopsis or a general forecast, although those are objects to be sought, but it resides preëminently in disposing of the more pressing problems of localization.

When the fire-weather forecasting was first undertaken it was based on the existing Weather Bureau organization —a wide network of stations whose telegraphic reports gave the forecasters at Portland and San Francisco a birds-eye view, so to speak, of weather conditions over the North American continent twice a day. By this means the forecasters were able to issue general

warnings of extremely dry or windy atmospheric conditions when the synoptic charts indicated their imminence over wide areas. The basic idea thus adapted was sound but it was far from being final so far as details of application and refinements of practice were concerned. For one thing the district forecaster was usually in ignorance of the exact state of the weather at the scene of a going fire. His reporting stations were located in the centers of population; not in the mountains or forests. He did not know what fires were in progress, nor where, nor what their degree of severity. Nor did he known anything of the special problems involved in the attack on any particular fire, nor how local idiosyncrasies of weather might affect them.

In short, what the forcaster needed was more detailed data and more assistance in digesting and applying them. Since the middle of the last decade a great deal has been done toward giving him these added helps. The U. S. Forest Service has contributed greatly to these results by multiplying reporting stations in forested areas. In California alone the number of ranger stations reporting to the forecast center daily during the season of fire hazard now exceeds 35, supplying specific information as to wind, weather, temperature and humidity. More effective cooperation is maintained with the Forest Service in other directions also. Today, if a fire is being combated for which detailed forecasts are required by the suppression forces, the forest official directing the attack may call on the district forecaster for daily advices covering the meteorological factors in his vicinity, these special advices being sent to him by telegraph until the need for them has passed.

The Weather Bureau has contributed substantially to the advancement of the project by creating a special fire-weather personnel consisting of men assigned to the study of this problem exclusively. One man is attached to each of the Weather Bureau stations at San Francisco, Portland, Seattle, Spokane, Boise, Chicago and Boston. Each devotes himself to the study of the fire-weather problems peculiar to the district under his purview, the localization of the forecasts and the standardizing and improvement of the weather reporting organization in the mountains and forests. Much of his time in the fire season is spent in the field. In the winter he is occupied in examining, compiling and digesting the data accumulated, and mapping the campaign for the season ahead.

Important among the schemes aiming at better localization is the mobile fire-weather forecasting unit. Heretofore the plan has been, in a sense, to bring the fire to the forecaster. The mobile forecasting unit attempts to bring the forecaster to the fire. Although still in its experimental stages, the service has already proved its feasibility to a degree that warrants its continuation. It consists substantially of a Weather Bureau office on wheels. A light auto truck has been equipped with radio receiving apparatus wherewith to intercept the broadcasts of weather data from the forecast center in San Francisco, thus enabling the forecaster attached to the unit to prepare synoptic charts at the scene of any fire to which he may be called, and thus putting at his disposal a fund of information both

general and specific from which to deduce forecasts of weather changes impending in the immediate vicinity.

A present project in all fire-weather districts, and one of basic importance, consists of a detailed survey of weather conditions affecting fires, particularly such elements as wind, relative humidity, and thunderstorms, by means of the establishment and operation of numerous special observing stations in forested areas. The information which the survey aims to secure is essential for successful forecasting, and has direct application to fire control, silviculture, forest pathology, and forest entomology. This project involves subsidiary projects relating to the improvement of methods and perfecting of instruments whereby the survey can be more effectively carried on.

Intensive investigation of certain fire-weather factors in their relation to fire start and spread is being made in the various districts, involving in particular special studies of relative humidity, thunderstorms, wind and precipitation. Hazard rating scales are also a subject of study with the object of evaluating the significance of meteorological factors in connection with fires. Projects for better localization of forecasts are also in contemplation: the mobile forecasting unit now operated in California represents one of them, and tests are to be made to determine the feasibility of applying similar methods of localization in Oregon and Washington also.

E. H. Bowie,
Meteorologist in Charge,
U. S. Weather Bureau, San Francisco.

Relation of the California Division of Forestry to the State-Wide Water Plan[1]

From the year 1889, when Wm. H. Hall, then State Engineer, made the first study of California's water resources and issued a report thereon, down to today, there have been numerous legislative actions taken, carrying appropriations amounting to hundreds of thousands of dollars to investigate the water problems and resources of the state and to recommend a state-wide policy for the conservation and use of its waters.

In 1921, the state legislature appropriated $10,000 and directed the State Board of Forestry to examine "reportedly large and increasing areas in this state which have been and are being denuded of timber and other vegetable protective covering and which, because of such denudation, are not only a present and rapidly increasing economic loss to the people of the state, but are also causing a rapidly increasing destruction of streams and harbors and are also interfering with and threatening to destroy, with constantly increasing rapidity, the availability of water for domestic, irrigation, hydroelectric power, mining, navigation and other necessary purposes."

The Board was instructed to examine these areas and report "a plan whereby they may be reforested or otherwise covered with protective vegetation."

You are all familiar with Examiner Munn's Report[2] and the findings as to the extent of denudation and devastation, the relation of forest influences to

[1]Presented at the 3rd annual meeting, California Section, Society of American Foresters, at San Francisco, December 19, 1930.

[2]Erosion and Flood Problems in California, by E. N. Munns. Report on 1921 Senate Concurrent Resolution No. 27, Calif. State Board of Forestry, Sacramento, 1923.

water conservation and erosion control, and which were emphasized as being the outstanding problems of the state. The report stated that the most effective plan for reforestation and recovering of denuded lands was careful, systematic and effective fire protection and that the state should take the leadership in fire protection and it further recommended the appropriation of sufficient funds to properly meet the State's obligations, and then returned to the State's treasury $3,041.49, unexpended moneys of the $10,000.00 original appropriation. A truly remarkable investigation. Since then the number of fires, the acreage burned and damages suffered have gradually increased.

The state's water studies have progressed until a mass of data as to run-off and stream flow has been accumulated and which have been condensed into engineering reports and recommendations as to control, storage and distribution. All of these studies are now being consolidated under the present Legislative Water Commission and the federal and state water committee, known as the Hoover-Young Water Committee, who will presumably make a report of their findings and recommendations in 1931, as to a coordinated state-wide water plan.

A group of forestry-minded men in California recently began to wonder what part forestry and forest influences would play in this report and in the state plan. They felt that the difference in run-off and erosion from forested and deforested slopes upon water conservation and stream flow regulation and water storage in a $5,000,000,000 proposed water plan should have some consideration, and that it should not be ignored nor accepted as a matter of small importance, nor considered as an unsolvable controversial problem.

After forty years of California water studies, the following two conflicting statements have been made by prominent water engineers, which indicates the confusion still existing in our water problem. One statement was to the effect that 75 per cent of all the state's waters reaches the ocean within 45 days after it falls in the form of snow or rain. This statement was made in support of a needed storage program. The second statement is that from 50 per cent to 75 per cent of the precipitation is consumed by the native vegetation of the watersheds. This statement was made in support of a needed increased water production program.

Within one drainage area we find the water users themselves were divided into two factions as to what constitutes proper watershed management. One favors burning the brush from the foothills so that more water will run-off into the closed basin in the valley below; the other faction protests the cutting of timber on privately- and federally-owned lands because of its stated detrimental effect upon the water crop.

The group of forest-minded individuals referred to, met with the joint Hoover-Young Water Committee and Legislative Commission by appointment and presented the several phases of forest influences upon California's water problems, asked that forestry be duly considered in their deliberations and findings, that a substantial appropriation be made for forest influence studies and that pending a final or satisfactory solution of all controversial questions,

that the committee recommended an adequate protection program as a part of California's water plan. A brief[3] presenting forestry's arguments was prepared by the executive committee of the California Section of the Society of American Foresters and presented to all members of the Committee. Later the State Board of Forestry was requested by the Committee to submit a statement covering the position of the Division of Forestry in the matter.

Pending the Report of the Joint Committee the Board of Forestry has presented to the Department of Finance, a Budget plan which progressively increases the state's financial support to the Division of Forestry for its approach to adequate protection for the state, and have supported and urged an item in the Department of Public Works Budget for forest influence studies.

These statements represent the attitude of the Division of Forestry as it now stands. A change in the make-up of the Division may extend the program within the next four years or may change it in its entirety.

Since your annual meeting of last year, I have remembered several times your president's reference to the advisability of the foresters of California becoming politically-minded. We have great need in California of the establishment of a well-rounded, sound and coördinated forest policy, properly financed, and the placing of that policy into a continuous and permanent program.

Good state forestry must necessarily be a long-term program, uninterrupted by four-year changes in state administrations.

It is essential for the welfare of California that a sound policy be developed and the necessary legislation enacted to make it continuous and there is no body of men better qualified to direct this work than the men in this Society.

H. S. Gilman,
Member, California State Board of Forestry.

[3]Relation of Forest Management to Water Resources. Journal of Forestry, Vol. 29, pp. 432-442. March, 1930.

Relation of the California State Division of Forestry to the Development of Industrial Forestry[1]

The State Division of Forestry of California naturally comes in close relationship to the logging operators and private timber land owners of the state through its administration of the various state laws relating to forests and forest protection. The most important of these are the law requiring forest fire patrol of pine forestlands and the law requiring fire precautionary measures in connection with private logging operations. Further it is provided by law that the State Board of Forestry, the policy-making body of the State Division of Forestry, shall contain a representative of the California redwood industry and a representative of the California pine region.

In my opinion there is a splendid opportunity for the State Division of Forestry to maintain and build up this

[1]Presented at the 3rd annual meeting, California Section, Society of American Foresters, at San Francisco, December 19, 1930.

contact with lumber operators on private lands, until it attains its logical leadership in encouraging and developing industrial forestry. Under present conditions it is generally admitted that the most important step leading to the development of industrial forestry in California is adequate protection of young growth and cutover lands.

Here is an immediate opportunity for the Division to show leadership in giving aid and advice to forest operators in slash disposal. Time is available for year-long employees to engage in this work at the close of the fire season. Two lines of the work can be taken up; the first experimental burning to determine the best methods of disposal by burning, and the second the assignment of state fire rangers to work with employees of lumber concerns in the actual burning and to aid them by advice and example. There seems no reason why this should not become an important part of the forest protection program of the state.

The primary effort in this disposal of slash should be to strike the best possible balance between reducing the fire danger and preserving the advance reproduction and the trees capable of serving as seed trees. In my opinion this can best be done by careful burning after the fall rains in strips and spots covering from 20 to 25 per cent of the cut-over area and designed to so break up the area that there will be a good chance of controlling future fires. There is opportunity also for much trial and experimental work to develop the most satisfactory and economical system. It will probably lie some where between the systematic strip system developed by the Fruit Growers Supply Company and the hit-or-miss strip and spot system used by the Michigan-California Lumber Company.

The State Division of Forestry has an equal opportunity to aid in the development of industrial forestry through its enforcement of the legal fire prevention requirements on private logging operations. Most is accomplished if moderation and an educational spirit is followed in making these state fire law inspections. The object should be to help the operator reduce and prevent fires. In this way the state inspector will gain the confidence of the men on the job and it is then easy for him to discuss with them the importance of advance young growth and the saving in operating cost through leaving the smaller trees, which in the future will be available for seed trees. By following out this plan it seems to me that the State Division of Forestry can render a real accomplishment in encouraging industrial forestry. With preservation of advance growth, protection of young growth on cut-over lands, and provision for seed trees very substantial progress will be made toward future industrial forest production.

SWIFT BERRY,
Manager, Michigan-California Lumber Co., Camino, Calif.

STATE DIVISION OF FORESTRY IN RELATION TO COUNTY FORESTRY[1]

There is probably no other state in the Union where county forestry or

[1]Presented at the 3rd annual meeting of the California Section, Society of American Foresters, at San Francisco, Dec. 19, 1930.

county fire protection is practiced so extensively as in California. That such a situation exists, coupled with the fact that up until quite recently the majority of these county units were operating independently of the State Forester's office (or State Division of Forestry as it is now called), would seem to indicate that in the past, state politics have had little sympathy with either the cause of forestry in general or local conditions in particular.

Other contributing factors are doubtless to be found in the diversified interests involved, as due to entirely different climatic and geographic conditions, the problems of the nothern part are far from similar to those of the southern part of the state. At times they are even found to be in direct contradiction.

The situation exists. What should be the policy for the future? Up to a certain point the perpetuation of our timber supply and the conservation of the watershed areas is undoubtedly the state's function, and an obligation that it must meet. To the Division of Forestry, therefore, remains the problem of deciding the policy that should be followed in determining the dividing line, where the obligation of the state ceases and where that of the local interests begins. In many localities the protection service demanded, due to purely local conditions, is far in excess of anything that the state could reasonably be expected to furnish. Should the counties be encouraged to build up their own organizations? If so, to what extent? If one hundred per cent, then there would be no need for a state forestry organization, and the counties would be entirely independent except for receiving their allocated *pro rata* share of any state funds. It is hardly within the realms of possibility due to the financial status of some counties that such a program could be accomplished, and if it were, without a doubt it would do far more harm than good for many reasons,—sufficient only to mention the fact that it would do away entirely with the possibility of any uniform state forestry policies, without which, nothing worth while can be accomplished.

The present state policy of coöperation with the various counties, in some cases by financial assistance only, and in others by financial aid plus supervision or state control, is doubtless a step in the right direction, and in some cases has proven to be the only efficient way in which to handle the local problems. A good illustration of this was found in the recent "Tri-Counties" situation in Southern California.

Here were found three counties,—Orange, Riverside and San Bernardino, all vitally interested in one common watershed, located in San Bernardino County, which county had its own Forestry Department, and yet due to local politics, jealousies and inter-county friction, Orange and Riverside counties could not see their way clear to cooperate financially or otherwise with San Bernardino. The state stepped in, took over entire control of fire protection in these counties, receiving appropriations from all three to supplement the state funds. This doing-away with duplication of effort has naturally resulted in increased efficiency at a lesser cost, allowing for better discipline of personnel, together with standardization of equipment, methods and local fire prevention legislation.

This policy works admirably where the counties are financially able to render assistance and where the interests of the county itself are an issue. However, it does not solve the problem of furnishing protection to cut-over lands where the counties apparently have little if any interest, or the protection of privately-owned timber, that possibly seems only to benefit some far distant city, or the protection of the "brush line" along the foothills of the Sierra Nevada Mountains where in many cases nobody cares if it is protected or not, its value and therefore the necessity of its protection not yet having been realized.

These problems which are just a few of the many, cannot be solved by the State Division of Forestry under its present financial conditions, and it is useless for the counties involved to expect relief until ways and means have been found either by special legislation, taxes or other methods, whereby sufficient funds are made available for their use. It would further help considerably if this state followed the example of others and took the State Forester's position and that of the Board of Forestry out of politics and placed them under Civil Service regulations. Political interference, whether local or state-wide, is the curse of the fire service, state, county or municipal, and until it is removed no very great progress can be made.

Several of the states, notably New York and Pennsylvania, are operating very successfully under one intensive state organization, and there is no question but what this is the ideal method. Whether or not it can be successfully practiced in California remains to be seen, and depends entirely upon the attitude and work of the Division of Forestry and the Forestry Board, and of their supporters.

Many of the counties, at present independent, have local problems where the investments at stake are so great that they will hesitate a long time before turning control over to the state organization unless they are assured very definitely that the state is in a position and properly equipped to take care of them adequately and continuously. They are expending large sums of their own money to take care of their own local problems and until the State Division of Forestry by actual proven accomplishments backed by a sound financial status can guarantee them 100 per cent service, they will continue to operate as they have in the past.

SPENCE D. TURNER,
Chief Forester, Los Angeles County,
Los Angeles, Calif.

REPORT OF THE COMMITTEE ON THE CONSERVATION AND ADMINISTRATION OF THE PUBLIC DOMAIN

The general policies and special recommendations of the above committee are reproduced below:

WASHINGTON, D. C., *January 16, 1931*
To the President of the United States:

The committee appointed by you, in accordance with the act of Congress approved April 10, 1930, to make a study of and report on the conservation and administration of the public domain, respectfully submits the following report:

You have submitted to the committee

problems for consideration which we summarize under five major topics:

1. The future disposition of the remaining vacant, unreserved, unappropriated public lands and the adoption of a definite program of conservation of grazing resources either through ownership or control by the States or by Federal administration.

2. The use and conservation of water resources including reclamation and flood control.

3. The conservation of subsurface mineral resources with respect particularly to the position which the States should occupy in any program.

4. The conservation of timber resources with special consideration of national forest areas, their usefulness within present limits, and the matter of additions to or eliminations from those limits.

5. Changes in administration which might produce greater efficiency in the conservation and use of the natural resources of the Nation.

Consideration of the questions submitted has led the committee to the following general conclusions and specific recommendations.

GENERAL POLICIES

It is the conclusion of the committee:

1. That all portions of the unreserved and unappropriated public domain should be placed under responsible administration or regulation for the conservation and beneficial use of its resources.

2. That additional areas important for national defense, reclamation purposes, reservoir sites, national forests, national parks, national monuments, and migratory-bird refuges should be reserved by the Federal Government for these purposes.

3. That the remaining areas, which are valuable chiefly for the production of forage and can be effectively conserved and administered by the States containing them, should be granted to the States which will accept them.

4. That in States not accepting such a grant of the public domain responsible administration or regulation should be provided.

5. We recognize that the Nation is committed to a policy of conservation of certain mineral resources. We believe the States are conscious of the importance of such conservation, but that there is a diversity of opinion regarding any program which has for its purpose the wise use of those resources. Such a program must of necessity be based upon such uniformity of Federal and State legislation and administration as will safeguard the accepted principles of conservation and the reclamation fund. When such a program is developed and accepted by any State or States concerned, those resources should be transferred to the State. This is not intended to modify or be in conflict with the accepted policy of the Federal Government relating to the reservation stated in conclusion No. 2 above.

SPECIAL RECOMMENDATIONS

1. That Congress pass an act granting to the respective public-land States all the unreserved, unappropriated public domain within their respective boundaries, conditioned, however, that in order to make the grant effective, the States desirous of accepting it shall so

signify by act of legislation. A copy of the accepting act signed by the governor and attested by the great seal of the accepting State, when transmitted to the President of the United States, shall operate as an application for the clear listing of the lands granted, and the proceedings thereon shall follow under the direction of the Secretary of the Interior, as in the case of selection heretofore made by public-land States under State land grants.

2. That for States not accepting the grant Congress shall include in the act a provision that upon the application of the State land commission, or State land commissioner, as the case may be, authorized thereto by the State legislature, the President should by Executive order designate the unreserved, unappropriated public domain in such State as a national range.

Existing laws and appropriations pertaining to the national forests should be extended to national ranges in so far as applicable, including grazing research and range improvements, and disposition of receipts, homestead provisions, and the prospecting for and utilization of minerals.

National ranges should include public lands withdrawn for mineral or other purposes when the use of the land for grazing is not inconsistent with the purpose of the withdrawal.

3. In the same act of Congress it should be provided that in the absence of legislation by any State within 10 years thereafter dealing with the control and administration of the unreserved, unappropriated public domain, the President, by Executive order, may establish, when authorized by Congress, a national range in such State, comprised of all such public domain, including lands withdrawn for mineral or other purposes whose use for grazing is not inconsistent with the purpose of the withdrawal.

4. Areas of unreserved and unappropriated public domain granted to the States shall be clear listed by the Department of the Interior in accordance with established procedure as to mineral or nonmineral character. In the case of lands classified as nonmineral in character, those passed to the States should be in fee simple, and pending the transfer of lands to the States the Federal Government should recognize in so far as possible any method inaugurated by the States to regulate the movement of livestock on such lands to prevent overgrazing that is not discriminatory between the States.

In the case of lands classified as mineral in character, title to the State should be in fee simple, except for the reservation in the United States of specified mineral or minerals found by the Interior Department to be present in the land at the time of clear listing, and with reservation in the United States, its permittees, lessees, or grantees, of the right to enter upon the lands, to prospect for, mine, and remove such minerals.

5. There should be temporarily excepted from the grant the areas shown in map No. 1, submitted to this committee by the Forest Service, entitled "Areas proposed by Forest Service as additions to existing national forests or for establishment as new national forests."

In order to determine what, if any, areas should be taken from or added to the national forests, a board should be created for each State composed of

five members, one designated by the President of the United States, one by the Secretary of the Interior, one by the Secretary of Agriculture, and two by the State. The power and duty of such boards shall be: (1) To decide what, if any, lands within such proposed areas shall be added to the national forests; (2) to decide what, if any, areas within existing national forests shall be restored to the public domain; (3) additions to national forests should be limited to areas chiefly valuable for forest purposes, except upon request of the State involved; (4) the board shall endeavor to correct and round out the boundaries of national forests by the consolidation of areas wherever practicable; (5) the board shall report its findings from time to time to the Secretary of the Interior and complete its findings within one year from appointment of the board.

The committee recommends the use of map No. 1 merely as a basis for consideration of the board, not as an expression of opinion or suggestion that those areas be added to the national forests.

The committee believes that this method of procedure will expedite clear listing of the remaining lands.

Whatever areas are not included within a national forest as a result of the decision of the board shall then pass to any accepting State to be clear listed in the same manner as the general grant.

The board herein created shall be organized upon the passage of the act and any State may elect to defer acceptance of the grant in paragraph 1 until the determination of the board has been made.

6. The board should also be authorized to select additional reservations important for national defense, for reclamation purposes and reservoir sites, for national parks and monuments, and for migratory-bird refuges, and to recommend that they be set aside for the purposes indicated and be excluded from lands granted to any accepting State, and such recommendation when received by the Secretary of the Interior shall have the effect of excluding such areas from the grant; provided, however, that there recommendations shall be filed with the Secretary of the Interior prior to the clear listing of any of the land which might be so reserved.

If a majority of the board, or in the case of national defense, and/or for reservoir sites on interstate streams, two members thereof request that a definite area for the purposes stated in the preceding paragraphs be excluded from the clear listing of any tract for further study to be given the subject, then the Secretary of the Interior shall exclude such definite areas from the clear-listed lands.

This board shall also have the power and it shall be its duty to make recommendations to the Secretary of the Interior for the elimination of lands from existing reservations, withdrawals, and classifications when such action is deemed proper by the board.

7. Areas restored to the unreserved and unappropriated public domain through the cancellation of any rights or claims or release of withdrawals should be subject to the adjudication and clear listing or reservation, as herein provided.

8. The Secretary of the department having jurisdiction over any of the lands

classified and disposed of as herein provided and remaining in public ownership should be authorized to exchange any of such lands with States or private owners for other lands of equal value with a view to consolidating ownership for more effective utilization and administration. In the making of such exchanges long-standing priority of use of grazing areas should be given due consideration and no exchanges completed until after full hearing has been accorded. Similar authority should be extended by an enabling act to the States as to any public lands granted thereby, and also as to any lands granted to the State by previous enabling or other acts.

9. In order to bring about the consolidation of existing State holdings within the States not accepting the general grant, so that administration and control may be more efficiently exercised, the State should be authorized, in the discretion of the Secretary of the department having jurisdiction thereover, to select any isolated area not in excess of four sections of the unreserved, unappropriated public domain, such as consolidated with near-by areas of State-owned lands, would effect the purpose mentioned; and upon clear listing of such selections, title should then pass to the State as in the case of other State land grants.

10. The Secretary of the Interior should be authorized to clear list areas previously withdrawn for the protection of stock-watering places and areas withdrawn for stock driveways upon a showing by the State that they are no longer required.

11. As to all grants provided for in the act, the land should pass to the States impressed with a trust for administration and rehabilitation of the public domain and for public institutions and with such restrictions as Congress might deem appropriate.

The following general restrictions are deemed desirable:

(a) The lands passing to the several States under the provisions of this proposal shall be subject to lease, sale, or other disposition as the State legislature may determine; provided, however, that all sales of such lands shall be made only at public auction after previous advertising and with reservation of subsurface minerals.

(b) None of such lands, nor any estate or interest therein, shall ever be sold or leased except in pursuance of general laws providing for such disposition.

(c) All proceeds arising from the sale or other permanent disposition of the lands and every part thereof shall be placed in a permanent fund to be safely invested and to be guaranteed by the State against diversion or loss.

12. The present conservative policy of reclamation development should be continued. Under it, construction expenditures each year are restricted to the payments from settlers and the income from other sources provided for in the law. If payments are not made, works will not be built. This makes of reclamation a sound business policy and is a strong influence toward maintaining the integrity of the contracts.

Where projects require a larger investment than can be met from the reclamation fund, they should be dealt with by Congress in special acts similar in character to the Boulder Canyon project act.

We recommend that, in the undertak-

ing of any project, there should be no interference with the laws of the State relating to the appropriation, control, or distribution of the water or with vested rights secured thereunder.

Past experience, coupled with the urgent need of additional funds for accelerating and continuing construction work on irrigation projects, points conclusively to the desirability of adopting a definite policy relative to hydroelectric development, under which the power receipts should be used; first, to repay the cost of the power plant and appurtenant works; second, the cost of the reservoir and dam which regulates the delivery of water to the plant; and after that, all net revenues should be credited to the reclamation revolving fund.

The policy should be continued of having a central organization to design and build works, but to transfer these works to the controls and management of the water users as soon as the projects are settled and developed.

13. We approve and adopt from the Report of Committee of the Irrigation Division of the American Society of Civil Engineers made October 4, 1928, the following:

"The conservation of the water in the rivers and lakes of the country should be under public control and in order to lay a proper foundation for the making of comprehensive plans the Federal and State Governments should gather data, compile statistics, and conduct studies necessary to determine the feasibility of projects.

"The regulation of the flow of streams for the prevention of floods and for the best possible utilization of the waters should be undertaken by the States, or jointly by the United States and the States under such suitable forms of cooperation as may be appropriate under the constitutional authority now delegated to each. They should prepare and adopt comprehensive plans for such regulation and should bear an equitable portion of the cost of water-storage and flood-control work when the economic aspects after full investigations are found to be favorable, and the remainder of the cost should be allocated to flood-control, irrigation, power-development, municipal water-supply, and other purposes.

"Where protection against flood waters results from the regulation of stream flow by means of reservoirs or otherwise, the proportion of the cost of the flood-control work not assumed by the Federal or State Government should be assessed against the lands and other properties which receive benefit therefrom."

14. Whatever be the method adopted for the use and disposition of the public domain, any final administrative act must be based upon a survey of the areas involved. It is therefore recommended that the Congress be asked to provide appropriations sufficient to enable the General Land Office to proceed immediately with the survey of the remaining unsurveyed areas.

15. In the administration of the public domain as a national range it is recommended that consideration be given to those methods which will perpetuate the best interests of the livestock industry, including long-time permits for grazing, and developing watering holes to permit the complete use of the range. The program should include consideration of a year-round permit system allocated so as to make the best use of the entire grazing areas of the State.

Careful consideration should be given to those areas vital for both grazing and watershed protection to the end that both interests receive constructive administration.

16. That the present ratio or participation by the Federal Government in the construction of Federal-aid highways be continued for a period of 10 years.

17. The location and protection of stock driveways should be given im-

mediate consideration. Pending the determination of the extent to which they should be transferred to the States accepting the grant, cooperative action between the Federal Government, the States, and the stock-raisers' associations as to use, location, and policing should be entered into where possible. Interstate driveways should be retained in the Federal Government and held subject to use determined by interestate agreements.

18. We adhere to the principle that in all matters clearly involving the interest of two or more States, but not that of the other States of the Union, all questions arising therefrom should be settled by agreement and compact so far as possible and not by Federal intervention, save an appeal to the courts where necessary. This principle has proved very effective recently and should be more frequently resorted to in the future.

19. It is the conclusion of the committee that as to agricultural and grazing lands, private ownership, except as to such areas as may be advisable or necessary for public use, should be the objective in the final use and disposition of the public domain.

20. In order to provide for a more effective administration of the public domain and the various reservations and areas now under the control of the Federal Government and to promote the conservation of natural resources, it is recommended that the Congress be asked to authorize the President to consolidate and coördinate the executive and administrative bureaus, agencies, and offices created for or concerned with the administration of the laws relating to the use and disposition of the public domain, the administration of the national reservations, and the conservation of natural resources.

The report continues with discussions of the foregoing recommendations and an appendix of tables concerning public lands.

Tags and Painted Numbers on Trees in Permanent Sample Plots

While measuring loblolly pine permanent sample plots in Maryland, a crew from the Allegheny Forest Experiment Station observed that aluminum tags attached to the trees with copper nails were corroded at the point of contact with the nail. At times this corrosion was so great as to cause the tag to fall, and in some cases become lost. Aluminum tags attached with galvanized nails were still in good condition. All of the tags were placed in 1926. The chemistry Department of the University of Pennsylvania attributed this phenomenon to electrolysis. Since aluminum and copper are widely separated in the electro motive series, "there is a tendency for the aluminum to go into solution in the presence of an electrolyte, whereas, aluminum and zinc are rather close together and there is little difference between their solution potential." By solution potential is meant the electromotive force of the current that is required to cause a deposit of metal from its normal solution. The humid climate (annual precipitation of from 40 to 42 inches) of the locality apparently furnishes sufficient electrolyte for electrolysis.

Figures which had been painted on

the trees in 1920 were still visible, although many of the tags which were attached in 1926 were missing. In one case some one had interchanged the tags on the plots, but due to the painted figures no confusion resulted. On such rapidly growing species as loblolly pine, a two-inch figure such as that made by the stamp, described by Berg in the JOURNAL OF FORESTRY for October, 1929, becomes more distorted and illegible than a three-inch figure. The three-inch figure may thus eliminate the necessity for frequent re-painting of the figures on the more rapidly growing species. In several cases, the figures painted on the north side of the tree were not as visible as those on the south side. This was due to a more luxuriant growth of lichens on the north side.

H. F. MOREY,
Allegheny Forest Experiment Station,
Philadelphia, Pa.

FOREST RESOURCES OF MANCHURIA[1]

The term "Manchuria" is applied in a more or less vague way to the northeasternmost territories of China, and embraces all lands lying east of Mongolia and northeast of the Great Wall. Manchuria, * * * * forms a roughly triangular area of about 380,000 square miles.

The border lands of Manchuria, except where the broad valley of the Liao River reaches the sea and in the northwest, where the extensive steppe lands of the Great Khingan piedmont make up the Barga District, are composed of broad mountain masses. These are for the most part densely clad in virgin forest and contain the bulk of all Chinese timber reserves. * * * *

Unlike most of China proper, where three thousand years of exploitation has left barren slopes and a dire timber shortage, the mountain lands of Manchuria are still largely untouched. In spite of local and international interest, however, these timber resources are a wealth of unknown magnitude. Many sections, especially in the Great Khingans, are not well enough known to allow a reasonable estimate. One fact is certain—the area in forest is vast, and each new estimate places a higher acreage and timber reserve than has been previously made. The Changpai and the Little Khingans are natural forest lands and have not been exploited to any appreciable extent, as is true also of the northern portion of the Great Khingans.

The hill country in Fengtien Province and the valleys and lower slopes of the Changpai have been ruthlessly cut out. The Chinese came as farmers and burned away the forest where it interfered with agriculture. In many places in south Manchuria, the peasants are already relying upon the stalks of *kaoliang* and corn for fuel. Both Russian and Japanese have entered into the wholsale cutting of the Manchurian forests. Exploitation is confined to areas where transport is relatively easy. Such areas are found where the Chinese Eastern Railway crosses the Great Khingans and the Changpai, and where streams are large enough for logging. The Yalu, the upper Tumen, the Sungari,

[1]From "The Geography of Manchuria," by Robert Burnell Hall. *The Annals,* Amer. Acad. of Pol. and Soc. Sci. Vol. 152, pp. 278-291. Nov., 1930.

TABLE 1.

DISTRIBUTION OF TIMBER IN MANCHURIA

Forest district	Areas in millions of acres	Million cubic feet of timber
Right bank of Yalu and basin of Hun River	2.40	3.6
Upper Sungari	3.52	8.7
Tumen Valley	2.04	4.2
Hurka Valley	1.55	4.2
Lalin Valley	1.55	3.0
Eastern section of Chinese Eastern Railway	5.96	8.98
Sansing	12.94	26.15
Great Khingan	34.30	56.00
Little Khingan	24.50	35.00
Totals	88.79	149.91

and the Hun are at present active transporters of log rafts. The cutting takes place chiefly in winter, and the logs are rafted out during the high water of the summer rains. The laborers enter the forests in late September, after the harvest is over on the plains.

Over three hundred species of trees have been identified, comprising eight coniferous and twenty-one broadleaf varieties. It is generally estimated that about forty per cent of the reserves are in conifers and sixty per cent in broadleaf trees. The Korean pine is the finest of the conifers and is most abundant in eastern and northeastern Manchuria. Larch, fir, and spruce are widespread. The Siberian pine is common in the Great Khingan. Oaks maple, elm, and poplar are important broadleaf trees. Birch forests occur north of Tsitsihar and throughout the northern Great Khingans.

Table 1, although possibly exaggerated, is as reliable as any and will give some notion of distribution.

The location of Manchuria between China and Japan, both countries deficient in timber, promises an active future trade. The commercial significance of timber is at present far inferior to that of agriculture. In 1927, forest products amounted to but 1.7 per cent of the total exports. The average annual estimated production of timber in Manchuria for the years 1923-1926 inclusive was 45 million cubic feet. The average import of timber for the same period was 7.4 million. Average export for the same period was 21.6 million, leaving a balance on home consumption of 30.8 million cubic feet.

RIVERS OF RUIN OR RIVERS OF WEALTH?

Flooding rivers in America should not be allowed to continue their careers of rapine and destruction, but should be tamed and exploited for their great resources in land fertility and fish foods. This was the thesis advanced by Professor James G. Needham, of Cornell University, when speaking before the American Association for the Advancement of Science at its annual meeting in Cleveland in December, 1930. Professor Needham called attention to the potential wealth in flood waters, as evidenced by the richness of the vegetation on river banks and the abundance of fish in the water. He pointed to China

for examples of both the right and the wrong ways of dealing with great rivers. "The condition of the rivers in China shows what has been done and can be done with flood waters," he said. "The contrast in treatment between the Hoang Ho, 'China's Sorrow,' and the Yang Tze 'China's Sustenance,' is very striking. The Hoang Ho is diked 70 feet above the plain and, breaking over betimes, floods grow more disastrous as the dikes rise higher; but the peaceful Yang Tze is spread out in canals over the plain, dropping its load of silt in the canals, whence the farmers recover it to fertilize their fields and keep them ever productive. They build the land high, they keep the bottom of the canals low, and the fishes developed in these canals provide nearly the whole of their meat supply. "Studies should be made to find out whether the results obtained in China by means of infinite hand labor might not be attained in the flood plains of American rivers by the application of new methods and the use of American machinery."—From *Science News.*

INTER-AMERICAN CONFERENCE ON FORESTRY

As the result of several years of effort on the part of the Pan-American Union, the first Inter-American Conference on Agriculture, Forestry, and Animal Industry was held in the Pan-American Building, in Washington, D. C., on September 8, 1930. This conference comes as the direct result of recommendations made in Havana in 1928, by the sixth International Conference of American States, and was made possible through the efforts of committees composed of leading experts on agriculture in each Latin American country. Eighty official delegates, representing twenty-one American republics, attended the conference, as did many consultative experts.

Two years were spent by the Pan-American Union and by the national committees in each country in preparing the agenda laid before the conference, and in adopting a comprehensive program which should include all the vital agricultural and forestry problems that the nations of the Americas must face in the fields of economics, plant disease, and the technique of agrciulture and silviculture. A great deal of the preliminary negotiations leading up to this conference were carried on by the late Doctor Wm. A. Orton, Director of the Tropical Plant Research Foundation, which has on more than one occasion served as a pioneer in the fields of tropical agriculture and tropical forestry.

The conference took the form of general discussion of stated topics, rather than a presentation of set papers. The two main topics for discussion in forestry were:

Reconnaissance forestry, soil and irrigation surveys. (1) Methods of procedure and organization of coöperative Inter-American forestry, soil and irrigation surveys. (2) Scope of such surveys. (3) Plans for utilization of results secured through the surveys in the development of industries and aid to agriculture.

Problems of Forestry. (1) Examination and classification of the forest areas of the various countries. (2) Deter-

mination of the existing timber, with indication of its quantity and quality. (3) Outline for a forest organization to determine the principles of management, exploitation, and reforestation of the forest areas, with the purpose of insuring their permanent productivity. (4) Provisions for a study in testing and utilizing the more abundant species of tropical America, with a view to making them available to the world markets.

The speakers on forestry were: Major Robert Y. Stuart, United States Forester; Senor Rigoberto Vasquez and Senor Jose del a Macorra, of the Mexican delegation; Senor Modesto Martinez, of Costa Rica; Dr. Vinicio da Veiga, of Brazil; Senor Julio Riquelme Inda, of Mexico; Senor Jose V. Cardoso, of Mexico; Senor Alberto Graf Marin, of Chile; Senor Decio de Paula Machado, of Brazil; Dr. Sergio Barojas, representing the Director General of Forests in Mexico; Major George P. Ahern, of the United States Delegation; Mr. Arthur Koehler, of the Forest Products Laboratory; Doctor E. P. Meinecke, of the U. S. Bureau of Plant Industry; and Mr. Wm. R. Barbour, of the Tropical Plant Research Foundation.

Various resolutions were adopted by the conference, among them being a resolution that, through its division of agricultural coöperation, the Pan-American Union take steps to gather material for the standardization of the terminology used in the sciences of agriculture, forestry and animal industry, and that, upon the completion of the material, each of the countries member of the Union be invited to join a conference to consider the means of bringing the information into widespread use. Other interesting recommendations were: (1) A resolution recommending the establishment of a central Pan-American Research Station, and (2) a resolution recommending that five members be appointed a committee to study the means of establishing a Pan-American Agricultural Bank, to have main offices in New York and branch offices in the various American countries, the object of the bank to be the furthering of agricultural credit throughout the Americas. Upon formulation, this plan is to be submitted to the Governing Board of the Pan-American Union, who will present it to the interested governments.

Specific forestry resolutions passed by the conference included:

A resolution recommending that the countries of America undertake surveys to determine the location, area, classification according to type, depletion by felling, fire, etc., of forests, and domestic wood requirements of each country, expressed in terms of utilization. It was further recommended that the Pan-American Union urge each country to carry out these surveys without delay, and that the Union gather and make known the data obtained by such surveys.

A resolution recommending that the countries of America, where no appropriate legislation is in force to this end, declare the preservation of forests to be in the public interest.

A resolution calling the special attention of the various governments represented in the Pan-American Union to the advantages of conducting forest exploitations in a rational manner and of giving particular attention to reforestation needs and to the preservation of watersheds as a protection against

soil erosion and floods.

A resolution recommending that there should be carried out in all the countries investigations of the forest characteristics and ecological behavior of the various species of forest trees and of the various types of forest.

A resolution that rules and regulations should be issued, after due consideration, in the countries where such rules and regulations do not exist, dealing with the indefinite conservation of the forests, in order to avoid the disappearance of forests due to the exploitation of secondary products, such as resins, barks, gums, etc.

That a unification of the forestal terminology of the American continent should be undertaken.

That the countries which may have carried out experiments on the utilization and industrialization of waste matter resulting from the exploitation of forests should communicate the results obtained from their investigations to the other countries of the American continent.

A resolution that each country take steps to investigate the technical properties and methods of utilization of all species of woods occurring in its forests in commercial quantity, that such investigation be carried through on an adequate and largely standardized basis, and that plans for systematic testing of American woods be formulated under the general guidance of the Pan-American Union or by a special international committee organized for the purpose.

A resolution recommending the advisability of inviting the nations of Latin America to introduce in the programs of agricultural education, and even of normal, secondary, and primray education, the teaching of forestry in the different grades as a means for bringing about conservation of forests.

To study the establishment of institutes for forestry research, in charge of experts; to conduct all kinds of investigations concerning the forest wealth available in each of the American nations; and to promote, through the intermediary of forest experiment stations, systematic management, reforestation, etc., the most adequate utilization of such resources in each forest region.

Before the adjournment of the conference on September 20, 1930, numerous entertainments were given for the delegates and excursions made to experimental farms, public monuments and other points of interest. Addresses were made by the Acting Secretary of State, Hon. Joseph O. Cotton; Secretary of Agriculture, Hon. Arthur M. Hyde, who also tendered the delegates a luncheon; and Secretary of Commerce, Hon. Robert P. Lamont.

The Washington Section of the Society of American Foresters entertained the delegates at a dinner held at the Cosmos Club, with Paul G. Redington presiding as toastmaster.

It is planned that another conference shall be held within the next five years, at a place and time to be fixed by the Governing Board of the Pan-American Union.

TOM GILL,
Washington, D. C.

KIRKLAND AND BRANDSTORM LEAVE UNIVERSITY OF WASHINGTON TO STUDY SELECTIVE LOGGING

Burt P. Kirkland and Axel J. F. Brandstorm, professors in the College

of Forestry, University of Washington, have accepted appointments in the Branch of Research of the U. S. Forest Service. The former will hold the title of principal forest economist, and the latter senior forest economist. In their new work they will study the economic desirability and practical application of group selective logging in the Douglas fir region.

Southern California Holds Rural Fire Institute

The Rural Fire Institute. held on the new campus of the University of California at Los Angeles on February 20 and 21, 1931, was an outstanding success in attendance, in quality of the papers and discussions presented, and in the display of modern equipment for fire fighting. This meeting marked the end of three years of intensive effort on the part of the Agricultural Extension Service of the University of California in placing essential facts of the rural fire situation before the people of the state. The large display of hand tools and other accessories and equipment for fire fighting attracted the attention of large numbers of students on the campus, who though not enrolled at the Institute, undoubtedly gained some knowledge of the importance of fire protection in southern California.

The first session opened with about 200 in attendance representing nine counties. State Forester M. B. Pratt presented some important facts about the 1930 fire record in California and emphasized the effect that better organization and equipment, coupled with increased effort in cleaning up of fire hazards, had in cutting down fire losses. Wallace Hutchinson and Walter Coupe in discussing this paper referred to the dangers of a complacent attitude on the part of fire control forces following a good season and urged intensified effort in educating the public in fire prevention.

T. H. Dennis presented a resume of the work of the State Division of Highways in removing fire hazards on more than 1000 miles of highway through the use of fuel-oil spray and early burning of grass and weeds. He closed with the significant statement that this work had been so successful that it was now considered a regular part off the maintenance program. County Forester Dunne of Santa Barbara County told of similar work with a trained crew of men which later constituted an important link in the fire control forces. Their roadside burning was done without previous spraying of the grass and was carried out last year on 99 miles of county highways at the remarkably low cost of $18.47 per mile. State Ranger W. D. Winters then told of the "community clean-up days" along foothill roads in Madera County where he and the farm advisor had been able to get a large amount of volunteer help from local residents in cleaning up fire hazards along strategic county highways.

Woodbridge Metcalf in his talk on progress in fire protection education reviewed some of the fundamentals of extension teaching and some difficulties in changing the attitude or habits of mind of large numbers of people and then told of the campaign of fire protection demonstrations, his work with 4-H Club members and the farm fire

prevention contest. He pointed out that these efforts, added to the work of other organizations, were gradually bringing about a real "fire consciousness" among large portions of the population of California. In discussing this paper W. M. Tanner told briefly of the work of the Los Angeles City schools in bringing instruction in forestry and fire prevention into the curriculum in a very practical way.

John Coffman in the last paper of the morning recounted the progress that has been made in developing a fire-fighting organization for the national parks during the past two years and emphasized the important place that new equipment is taking in protecting these federal properties.

The first part of the afternoon session was devoted to demonstrations of the various pieces of motorized equipment displayed by state, county and federal fire services. They demonstrated their effectiveness in throwing water, and each of them climbed a 26-per cent grade with full load. This was the greatest concentration of rural fire-fighting trucks ever brought together and varied from the six-wheel Moreland just built to cope with sand conditions in Madera County, through the power-ul new trucks of the Angeles National Forest and the Los Angeles Forestry Department, the new Mack truck assembly similar to those recently constructed for the Ventura County fire district, to the new Ford truck of the State Division of Forestry which carries 125 gallons of water in its tank and combines effective performance and portability with low cost. The demonstrations closed with a showing of the new experimental tractor and trailer outfit of the Los Angeles City fire department. The tractor pulled the 600-gallon trailer up a 33-per cent grade and through some heavy brush fields while water was thrown on an imaginary fire by means of a type "N" Pacific Pumper mounted on top of the trailer tank.

Mr. J. P. Fairbank of the Extension Service demonstrated and explained the Jaccuzzi injector-type tank filler which will lift water from a source 75 to 80 feet below the truck by the venturi-tube injector principle. By saving enough water in a rural tank truck to fill the necessary length of hose to such a water source, it is possible to get a total flow of 75 gallons per minute into the tank by putting 40 gallons per minute through the injector—a net gain of 35 gallons per minute. It is evident that this little device may save many miles of travel for water at critical periods during a bad fire.

County Forester Spence D. Turner presided at the afternoon session which brought out more discussion on motorized equipment of several kinds. Friction losses in fire hose and the care and handling of fire hose were discussed.

Director E. I. Kotok of the California Forest Experiment Station emphasized the importance of fundamental research work in the working out of difficult problems in the fire protection campaign and paid tribute to the various agencies which have coöperated in the development of the many kinds of new equipment. City Fire Chief Scott in discussing the paper told of the research work he has had to do over a series of years in developing satisactory equipment to safeguard the large mountain areas within the city of Los Angeles. He and County Forester Turner

are giving each other good coöperation in the solution of many mutual problems.

On of the most interesting papers of the Institute was that of Mr. J. I. Thomas of the Board of Fire Underwriters of the Pacific in which he outlined the relation between rural fire organization and insurance rates on farm property. He pointed out that while it had been possible to grant reductions in premium on grain insurance because of recent progress in some districts in organization and installation of tank-truck equipment, that the companies must proceed slowly in making any similar reduction in rates for insurance on farm buildings, because larger amounts of water are necessary and special fire fighting technique is demanded in controlling fires in structures. Mr. Fred Cromer in discussing this paper brought out the interest that the county mutual insurance companies have in the movement for better rural fire protection and expressed appreciation of the unified effort to bring this about that was evidenced in the Institute itself.

About 110 of those attending the Institute gathered in the evening for a dinner and during the meal were entertained by the Los Angeles County Forestry and Fire Protection Orchestra, a group of nine musicians all of whom are regularly employed in the County Forestry Department. Following the meal Frank Thompson of the State Forestry Division described the latest developments in portable radio communication in connection with fire control. He displayed one set weighing less than 50 pounds with which he has successfully talked across 75 to 100 miles of distance on several occasions.

Saturday morning the session was presided over by Herbert Gilman of the State Board of Forestry and opened with a presentation by Jay Price of the Forest Service of developments in fire-fighting equipment. Progress of very real nature was shown in the development of portable pumping outfits, flame throwers for back-firing, knapsack pump outfits and attachments, nozzles for more efficient use of water, portable grinders and light-weight cooking and serving outfits for fire fighters. In discussing this matter, Fred Funcke emphasized the need for less weight and greater portability in portable pump outfits without sacrificing any efficiency and made the prediction that many kinds of specialized light equipment would be developed soon.

One of the outstanding papers of the Institute was that of Charles J. Kraebel on "The Fire Problem and Erosion Prevention in Southern California Watersheds." He illustrated his remarks with a number of excellent slides and left no doubt in the minds of his hearers of the vital relationship of fire protection to the permanence of water supplies and prevention of destructive erosion and floods. Dr. O. L. Sponsler of the University of California at Los Angeles, Botany Department, in discussing this paper, made a plea for more concerted attention to the whole problem of land management in southern California for water production and suggested setting up a special curriculum in the University for the training of men to handle these very specialized problems.

Engineer E. C. Eaton of the Los Angeles Flood Control District stated in no uncertain terms his conviction that adequate vegetation on mountain slopes is an integral part of a program of flood control. He pointed out the very serious effects of the burning off of large areas of vegetation which had been counted on to check run-off in figuring the storage capacity of flood-control dams, and urged greater progress in bringing more effective fire protection to all of the watershed areas in southern California.

The meeting voted to continue the Institute with annual meetings held alternately in northern and southern California.

WOODBRIDGE METCALF,
University of California.

SECOND ANNUAL MEETING OF THE SOUTHERN CALIFORNIA ASSOCIATION OF FORESTERS AND FIREWARDENS

The Southern California Association of Foresters and Firewardens held its second annual meeting at Avalon, Catalina Island, February 21-24. This followed immediately after the adjournment of the Rural Fire Institute held at the University of California at Los Angeles, under the auspices of the state agricultural extension service.

The Southern California Association of Foresters and Firewardens came into being just two years ago. This was the result of a need among men in the public fire service to form an organization for their mutual benefit and education. Their motto "For Unity of Thought and Action" expresses the purpose of the organization. Membership is open only to those in the employ of some rural or mountain fire prevention agency of southern California. Its membership totaling approximately 120 paid-up members, includes U. S. Forest Service officers, county fire wardens and state fire rangers.

In southern California there are four national forests, three counties with their own fire organization and seven counties under the jurisdiction of state fire rangers. Already these groups have been drawn closer together in coöperative fire prevention and control agreements; also by holding quarterly Directors' meetings, and their big annual meetings. The Association has already materially aided in obtaining needed county ordinances and state laws, as well as the standardizing of present laws and ordinances. The Association members have worked together to develop new types of motor equipment and there are now over thirty pieces of forest fire fighting tank trucks in southern California.

The Catalina meeting started on a Saturday and lasted until the following Tuesday, the intervening Sunday being spent on a goat hunt. Some of the papers discussed included the following: "Why Southern California Should be Interested in California's Lumber Industry," by S. R. Black. M. B. Pratt, State Forester, gave a report of "The Obligations and Future Policy of the State Division of Forestry in Southern California." "Some of the Reforestation Problems in Southern California" were discussed and illustrated with slides by C. O. Gerhardy, Assistant Forester of Los Angeles County. "Forest

Protection in Southern Califronia." "Fire Control as A Community Problem," by E. I. Kotok. "Conscription of Fire Fighters—Its Advantages and Disadvantages," by Frederick H. Cowles, Chairman, Fire Prevention Committee, American Green Cross.

"Reducing Equipment Losses on Major Fires," was discussed by E. W. Corrick, Assistant Fire Warden of Los Angeles County.

The meeting closed with a business session, at which time forestry, game and fire bills before the present state legislature were discussed and recommendations made as to their value.

J. E. Pemberton,
Assistant County Forester,
Los Angeles County.

Forest Fires in the Mississippi Bottomlands

The summer of 1924 was characterized by an insufficient amount of rainfall throughout the lower Mississippi Delta. A dry fall and winter followed. Many of the usually moist and wet areas in the bottomlands had dried out by the early spring of 1925 and many serious fires resulted. Although foresters and timbermen generally, discount the fire problem in the southern hardwoods, a real problem exists. The fact that much of the damage caused by the 1924-1925 fires is now manifesting itself, shows how sure and insidious this damage really is. On an 81,000 acre tract of virgin timber in the heart of the Mississippi Delta, the superintendent has estimated that the virgin red gum, as a result of fire injury, is deteriorating at the rate of one per cent or more per year. On a similar tract a study in 1928 revealed that there had been a loss of 20 per cent in the value of the timber at the time it was cut due to the loss brought about by decay following the fires of 1924-1925 and the similar fires of 1916-1917.

The fire situation in the Mississippi Bottomlands of Louisiana, Arkansas and Mississippi, at the present time, March 1931, is analogous to the situation in the spring of 1925. The past summer, 1930, was decidedly dry and was followed by a fall and winter also quite dry. Many sloughs and brakes usually filled with water have been dry for several months. The spring rains have not been able to wet down the litter and debris and conditions in the woods are just right for fires to spread.

On a recent field trip a cut-over area of once-virgin red gum in Madison Parish was inspected by a party from the Southern Forest Experiment Station. This tract was logged in the summer of 1928 and, as is usually the case in virgin stands, the area was practically clear cut. Following this cutting a fair stand of hardwood reproduction,—ash, oak, and gum—had become established. At the time of the visit, February 11, 1931, a fire was burning over a large portion of the cut-over area. This fire was so hot that most of the advance reproduction was killed and larger residual trees were partly consumed by the flames. Fires of a similar nature were burning in other cut-over and uncut hardwood stands in the region, and in no instance was any attempt being made to suppress the fires. The damage in hard-

wood stands of merchantable or nearly merchantable size may not be apparent for several years, for, unlike most pines, the hardwoods cannot exude a protective resin coating to protect them from insects and fungi. It is probable that much of the loss really caused by the fires will be laid directly at the door of the drought. While it is true that old over-mature trees and trees of poor resistance did die from the 1924-1925 drought and other similar trees will no doubt die from the 1930-1931 dry spell the greatest loss will be that occasioned by fire.

For several years the writer has taken every possible occasion to call the attention of foresters and timberland owners to the fire situation in the southern hardwoods, but for the most part he has been unheeded "like one crying in the wilderness". Most of the state foresters in the South still make up their protection plans, solicit funds for fire prevention and suppression, from pine timberland owners and allocate the funds obtained under the Clarke-McNary Act entirely on a basis of protection of pine lands. These lands certainly need protection and lots of it, but there are often greater values to be protected in the hardwood areas and often at less expenditure of time and money. If timber growing on an appreciable scale is to be practiced in the bottomlands, the solution of the fire problem is going to be one of the first essential steps.

G. H. LENTZ,
Silviculturist,
Southern Forest Experiment Station.

JUDD PROPOSES TERRITORIAL MONUMENTS FOR HAWAII[1]

In the February 1931 issue of *The Friend*, "oldest newspaper west of the Rockies," of Honolulu, C. S. Judd, territorial forester, proposes a plan of territorial monuments for Hawaii, similar to the national monuments in continental United States. The plan proposes to make "monuments" of places of prehistoric, historic, scenic, and natural science interest in order to assure their preservation. The plan does not concern such places already protected within the Hawaii National Park. Hawaii abounds in places and objects of great scientific, scenic, or historic interest which are in danger of ruin or extinction unless given official protection. Mr. Judd lists many such, from rare individual species of trees, to scenic lookouts and areas of geological and ethnological interest, and offers suggestions for legislation and otherwise for putting his plan into effect.

WACKERMAN ARTICLE REPRINTED IN SOUTHERN LUMBERMAN

The paper, entitled "The Management of Shortleaf and Loblolly Pine For Saw Timber" read by A.E. Wackerman at the Society's 30th annual Meeting recently was reprinted in full by the *Southern Lumberman* in its Feb. 15, 1931 issue. The editor, in addition, treated it editorially as follows:

"A refreshing variant from the familiar type of theoretical articles on forestry and forest management is found

[1]Since this note went to press, word has been received that the bill authorizing the designation of national monuments has been passed by Hawaiian legislature and signed by the Governor.

in an article in the current issue of the Journal of Forestry, written by Mr. A. E. Wackerman, forester of the Crossett Lumber Company, Grossett, Arkansas. This article we have reprinted in full on pages 38 and 39 of this issue of the *Southern Lumberman.*

"Mr. Wackerman is a trained scientific forester but the article is written with the authority and experience of actual practice. It is not a hypothetical example of what somebody ought to do, but is the story of the continuous—yield program for the partially cut-over forest property of large size, whose forestry scheme he is himself actually directing.

"Too much of what is written about forestry is extreme in its nature. There are ultra-optimists who paint too glowing a picture of what can be done, and at the other extreme the ultra-pessimists, who throw up their hands and claim that nothing can be done. Actual experience shows the weaknesses of both extremes, and Mr. Wackerman's article ought to be read carefully by every southern lumber manufacturer who would like to make his operation a permanent one.

"Mr. Wackerman in the closing sentence of his article makes a statement to which all lumbermen can agree: 'Above all, we must work out a plan that is not only practical but reasonably profit able, because forestry is not a fetish or a cause or a slogan, but a business, and it must yield dividends.'

"Where conditions are such that the stand of timber can be so managed as to establish continuous yield, and this can be done on a basis that will yield dividends, it is reprehensible for the timber owner not to arrange for operation on this basis. He should study the experience of operations like that at Crossett and see if he cannot find in such experience an example which he may profitably follow."

New Wild Life Film Available

Quail, grouse, wild ducks, wild turkeys, moose, elk, deer, bears, and the elusive trout and bass in their native habitats, are featured players in the new 1-reel motion picture "Forest Fires—or Game?" just released by the U. S. Department of Agriculture. The film was warmly praised at a pre-release showing before a special audience of foresters and representatives from the various bureaus of the department and from the Bureau of Fisheries and the American Forestry Association, both for its timely message and for its unusual fish and game scenes.

This film, arranged and sponsored by the Forest Service and made and distributed by the Office of Motion Pictures, Extension Service, shows how protected forests provide homes for game birds and animals and other wild life and for trout and bass in protected mountain streams, and how forest fires and destructive logging methods destroy these homes and, together with unrestricted hunting and fishing, make restocking necessary.

The picture was filmed in the mountains of North Carolina and in various national forests and game reservations throughout the United States. It includes much unusual fish and game photography, such as a mother quail on her nest, a mother wild goose and

her family, bears climbing up and down a tree, fish eggs in the process of hatching, and various fly-casting scenes.

This film may be borrowed free, except for transportation charges. Reservations for bookings should be made with the Office of Motion Pictures, Extension Service, U. S. Department of Agriculture, Washington, D. C. Prints made from the department's negatives may be purchased at cost of printing (amounting to about $27 for a 1,000-foot reel on 35 mm. slow-burning stock) by State forestry and fish and game departments, schools, colleges, boards of education, and other authorized organizations and individuals.

Selective Logging and Close Utilization—A Solution to the Slash Problem in Northern Hardwoods

The Lake States Forest Experiment Station in its Technical Note No. 31 reports that measurements on representative cut-over areas in northern Wisconsin and on the Upper Peninsula Experimental Forest at Dukes, Michigan, show the relationships between degree of cutting, degree of utilization, and the amount of slash shown in Table 1.

"Slash space," expressed in cubic feet, which is the depth of slash multiplied by the area occupied by it, is used as a basis for comparison. On the clear-cut hemlock-hardwood plots, there is over four times as much slash as on the clear-cut plot in pure hardwoods. Hemlock cuttings leave more heavy slash than hardwood cuttings of the same volume. The Wisconsin plots, besides having over 50 per cent hemlock, were cut for sawlog material only. On the Michigan plots, utilization was much closer, for, in addition to sawlogs, from 13 to 38 cords of "chemical wood" were cut per acre from the tops, cull pieces, and small trees.

Selective logging and close utilization contribute materially to the solution of the slash problem in the Lake States.

Table 1.

RELATION BETWEEN DEGREE OF CUTTING AND UTILIZATION

Kind of cutting	Sawlog volume cut per acre *Board Feet*	Per cent of original sawlog volume cut *Per Cent*	Percentage of ground covered by slash: Heavy[1] 1′—10′	Medium 4″—1′	Light 1″—4″	Total *Per Cent*	"Slash space" (Depth x area) per acre *Cubic Feet*
			Hemlock-maple-birth forest—Wisconsin				
Selective	9.040[2]	77	8	13		21	11,540
Clear Cut	8,594	97	34	7		41	60,740
			Maple-birch forest—Dukes, Michigan				
Selective	3,505	39	1	4	3	8	2,250
Selective	4,523	44	2	5	20	27	4,640
Selective	6,773	68	2	10	18	30	5,950
Clear cut	10,372	100	4	12	8	24	11,040
Clear cut	11,934	100	4	20	8	32	13,360

[1]Figures show depth of slash corresponding to different grades.
[2]Cut was mostly of very large trees.

Melin's Book on Mycorrhiza Translated by Stickel

The important book on tree mycorrhiza entitled "Investigations of the Significance of Tree Mycorrhiza, An Ecological-Physiological Study," by Doctor Elias Melin of the Mycological Laboratory of the Forest Academy at Stockholm, has been made available for English readers through a translation prepared some months ago by Paul W. Stickel of the Northeastern Forest Experiment Station.

Mr. Stickel's translation was handled with fidelity to the original, and he deserves commendation for his interest and the labor expended. The translation, embracing 173 pages, is available in a lithoprinted form from typewritten copy. It was produced by Edwards Brothers of Ann Arbor, Michigan, from whom it may be had at $2.25 a copy.

The principal headings include the following: (1) The present day knowledge of the nature of the root fungi of trees; (2) The root fungi in pure cultures; (3) The seedlings in pure culture; (4) The seedling and fungi in pure cultures; (5) Conclusions concerning coniferous tree mycorrhiza in nature; and, Conclusions. Following the conclusions, are 38 pages of tabular material and a 7-page bibliography. Illustrations number about 50, the figures being taken from the original.

E. F.

Effect of Forest Cover on Drought Injury to Undergrowth

In 1926 four one-acre samples plots were established in 55-year old jack pine on the Chippewa National Forest. Three of the plots were cut in varying degrees while the fourth was left uncut. The original purpose was to discover which method of cutting might favoı Norway pine reproduction.

On August 22, 1930, at the height of the dry period, observations were made on the thrift of the plants found growing on these plots. Each plant was listed as thrifty, poor or dead. The summarized results are shown in Table 1.

From this the Lake States Forest Experiment Station in its Technical Note 33 concludes that the more dense the forest canopy, the better is the survival of the plants underneath. Protection from direct sunlight seemed to be necessary for good survival during drought. This fact was confirmed by observations elsewhere on the forest.

These findings have a direct bearing on planting practice. Where injury from draught is likely to occur, trees should be planted where they will re-

Table 1.

EFFECT OF COVER ON PLANTS DURING DROUGHT

Type of cutting	Number of trees left	Per cent of normal basal area left	Total number of plants observed	Thrifty (Per cent)	Poor (Per cent)	Dead (Per cent)
Heavy cutting	108	15	45	15	38	47
Moderate cutting	205	45	47	21	45	34
Light cutting	239	58	47	23	43	34
No cutting	355	93	50	46	48	6

ceive shade during the hottest part of the day. The north sides of stumps, snags, logs and other objects should prove to be favorable spots. Natural vegetation, such as willows, alder or large toothed aspen, will provide a good protective shade. Dense hazel brush and aspen suckers should be avoided, however, as they cast shade too dense for normal growth of young trees.

Civil Service Examination

Announcement is made by the United States Civil Service Commission that the position of Assistant Chief, Plant Quarantine and Control Administration, Department of Agriculture, is vacant. Instead of the usual form of civil-service examinations the qualifications of candidates will be passed upon by a special board of examiners.

Applications must be on file with the United States Civil Service Commission at Washington, D. C., not later than May 13, 1931. A minimum of ten years' responsibility for the administration of important plant quarantine work will be required.

Charles Guyot, Eminent French Forester, Dies

France lost a great forestry figure on December 24, 1930 in the death of M. Charles Guyot, formerly Director of l'Ecole Nationale des Eaux et Forêts. M. Guyot was 86 years of age at the time of his death and ranked very high in the forestry profession of France as teacher, administrator, author, authority on forest law, and collaborator on the staff of *Revue des Eaux et Forêts.* He joined the staff of the school in about 1870, serving in various capacities, becoming finally Director. As a member of its staff he saw the school through its difficult period of reorganization and helped develop it to its present commanding position. He was retired in 1910, but continued until shortly before his death his contributions to *Revue des Eaux et Forêts,* as editor of its department of Jurisprudence.

German Foresters to Hold Big Meeting in Vienna

The German Society of Foresters will this year hold its annual meeting in Vienna. It will extend from August 30 to September 7, and more than one thousand German and foreign foresters are expected to be present. The first three days will be devoted to the reading of papers; these will be followed by excursions to selected forest regions in Austria and Bavaria. On September 2 there will be a demonstration of the latest devices used in logging, transportation, soil preparation, and insect control. The German society invites American foresters to attend and participate. Further particulars may be obtained from Deutschen Forstvereins, Berlin, S. W. 11 Dessuerstrasse 26.

REVIEWS

Suggestions for the Management of Spruce Stands in the Northeast. By Marinus Westveld, Northeastern Forest Experiment Station. *U. S. Dept. of Agri. Circular 134. 1930.*

This is a timely supplement to Dana's recent bulletin, *Timber Growing and Logging Practice in the Northeast.* It offers suggestions based largely upon the author's own recent investigations, for the management of spruce stands in the spruce and northern hardwoods region of New England and New York. The similarity of conditions in the southern part of the Province of Quebec to those in northern New England, and the author's acquaintance in the Province, justify the interest of Quebec foresters in these suggestions.

Immediate emphasis is laid on the following features: the prime desirability of an abundance of spruce and fir reproduction at the time of harvesting; the comparatively slow pace at which restocking takes place after cutting; the fact that over a large percentage of spruce stands seed trees are not a vital need in the production of a new crop, and that they are usually doomed to destruction because of the tendency of the spruce and fir to be thrown by the wind; that the advance softwood reproduction is the main reliance for the new crop; and that successful management lies in preserving and developing the young growth, even in some cases the thrifty young hardwood growth, already established in the forest at the time of cutting. The remarkable recuperative ability of spruce stands even under harsh treatment is especially noted.

The suggestions for cutting are discussed separately for pure softwood and for mixed hardwood-softwood stands, since each presents a distinct set of conditions. The author recognizes that measures such as he suggests are never applicable uniformly to the region as a whole because of the varied conditions encountered in spruce stands, and that certain measures, while effective and desirable in themselves, are not applicable at present because of economic conditions. The suggestions are as follows:

1. Pure softwood stands of the spruce swamp, spruce slope, and such as occur commonly in the spruce-flat type, should be clear cut as a general policy, since coniferous reproduction is ordinarily abundant. Cut-over lands of this character bear uniformly good stands of young softwood growth.

2. In young even-aged stands under pulpwood size, porly stocked with reproduction, one-quarter to one-half the young trees should be removed in a shelterwood cutting creating conditions favorable for the establishment of young spruce and fir seedlings. Great care must be exercised in effecting this cut

due to danger from windfall. After 5 to 10 years the remainder of the stand may be logged.

3. In mixed hardwood-softwood stands where advance reproduction of the desired species is adequate, best results are obtained by cutting all merchantable hardwood and softwood. The degree to which the advance growth is benefited depends upon the severity of the cutting.

In putting any of these cutting methods into effect, the height of the reproduction must always be considered; in the spruce-flat type, and in the yellow birch—spruce sub-type height is less important, but even here the softwood advance growth should be at least two feet. On the sugar maple—spruce sub-type the height of the reproduction should be four feet.

Swamping out skid roads, construction of bridges, skidways, and corduroy roads should be carried out with the saving of reproduction in mind. Damage form this sort of work at present ranges from 20 per cent to 40 per cent of the young stand.

4. Where seedlings are undersized, a preparatory cutting, or the girdling of a few of the larger hardwoods will accelerate height growth.

5. Removal of the hardwoods in advance of the softwoods, where there is a market for the hardwoods, effects a great reduction in hardwood seed production.

6. Clear cutting of mixed stands unsatisfactorily stocked with spruce and fir results in the rapid development of clean-boled young trees, mostly hardwood.

7. If all-aged, the stand can best be cut under the selection system, the severity of the cutting depending upon the prevalence of birch; the more birch the lighter the cut should be, due to the deterioration of newly exposed birch crowns.

It is questionable, the author finds, whether any scheme of cutting will have any material effect on the relative abundance of spruce and fir in the next crop. The fir always responds more quickly to any opening of the stand.

8. Frequent and heavy cuttings of fir in mixed stands of spruce and fir, should tend to increase the ultimate representation of spruce.

9. Girdling is advocated for destroying the dense overhead canopy of residual hardwoods in mixed stands. The author emphasizes the need of restricting the practice to trees which are suppressing advance reproduction, or of eliminating only trees of poor form and quality.

10. Cleanings are found to be most effective five to eight years after cutting or girdling, and can be done with a machete or small axe, while it one waits for from eight to fifteen years after cutting, the larger axe is necessary and the operation becomes costly. \$2 to \$4 per acre for cleaning out 2,400 to 5,000 young hardwoods, and releasing 1,100 to 1,800 young conifers, are figures given for experimental cleanings on sample plots in the White Mountains.

11. Grazing is favored as a means of keeping down undesirable sprout and brush growth.

12. Brush burning is strongly urged as the best method of slash disposal, lopping and scattering as an alternative. It is not unusual to find 25 per

cent of the ground covered with slash which not only crushes and kills advance reproduction, but prevents for many years, the establishment of new growth. Costs for complete disposal of brush by burning are given as ranging from 75 cents to $1.50 per thousand board feet.

Without question the silviculture which is being gradually built up in the Northeast will develop along these lines; and without question most of the measures which the author suggests will play important parts in the future management of spruce and fir and hardwood stands, especially in the management zones close to the market, which include the municipal forests, the farm woodlots, and the demonstration forests. These will doubtless serve as centers from which such practices will spread into the more remote management zones; so that there will be developed a silviculture for the Northeast comparable to that in Europe, by which I mean wholesale methods of forest culture which, we have been reminded, have been there invented, put into practice, and perfected over a period of centuries. We should recall also that hardwoods play an important economic rôle in those localities where silvicultural conditions are most nearly like our own. The author does well to ask, "Who can predict what demands there will be 20 years hence for high quality hardwoods?" We do not know what developments in the utilization of even inferior hardwoods will have taken place in that time.

There are many of us, especially those employed in the pulp and paper industry, whose work is concerned also with the forests in the more remote management zones which constitute the bulk of the northern spruce forest. The author would be the last to maintain that all these suggestions are applicable on such lands. Let us then consider for a moment which of the above measures do stand a reasonable chance of application on these remote lands which have come to be called of late the industrial forests.

We realize that, in very intensive work, no one silvicultural measure is widely applicable in a region as a whole, but we must at the outset restrict ourselves to seeking measures which are as widely applicable as possible, even if some acres escape production entirely due to the extensive manner in which these operations must be conducted.

We must admit forthwith that all intermediate cutting methods, all cultural measures involving an outlay of money must be eliminated from consideration, and that all reliance for the next crop must be placed in measures carried out at the time of harvesting. The best we can expect to accomplish is some modification of the clearcutting method, as recommended in (suggestion 1 above), with scrupulous attention to protecting the young growth from injury, and with a reasonable amount of slash disposal, probably by lopping and scattering. These requirements must be brought forcibly to the attention of jobbers and inspectors, so that the working crews themselves become more workmanlike, and take some pride in this aspect of their work. The time is not distant when a worker who is careless in respect to young growth will receive

about the same consideration as one who is careles in the use of fire.

Fortunately the spruce slope, the spruce flat, and the spruce swamp types together comprise a large proportion of the northern spruce forest, so that the harvesting operation can be applied on a fairly broad scale and still fulfill reasonable silvicultural requirements. As a rule, as both Dana and the author recognize, regeneration is plentiful in these types, but this feature should determine the extent of the application of clearcutting in all cases; where the reproduction is adequate the clearcut areas may be as large as need be; where it is not so abundant, they should be in the form of strips or groups and should be as narrow or small as the job can possibly stand.

I cannot join unreservedly in the revival of interest in the girdling of hardwoods. It seems to me to be a measure of limited application. It should be restricted in any event to overmature and decadent trees (why not any such tree, softwood or hardwood?), when these trees are suppressing young softwood growth. It is a cultural measure, together with the liberation cuttings, thinnings, and cleanings; in zones close to market where business conditions permit more intensive methods, perhaps the girdling of decadent trees is justifiable. Even in this case why not remove them for fuelwood? This leaves us then one legitimate, somewhat limited field for the application of girdling,—namely, the outer margin of the closest management zone, comparatively close to market, but just too far away to pay for the removal of fuelwood. I cannot conceive an owner operating for business reasons going farther afield to girdle decadent trees.

The underlying thought in this paper is one of undoubted significance. It is expressed in one sentence, and Westveld deserves congratulations for presenting and emphasizing it. "Successful management lies mainly in preserving and developing the young advance growth already established in the forest at the time of cutting." Opinions may differ as to how far it is necessary to go in the developing process, but this simple fact is one of major importance.

VICTOR BEEDE,
Brown Corporation, Quebec.

Control of the White Pine Weevil on the Eli Whitney Forest. By William Maughan, Instructor in Applied Forestry, Yale University. *Bulletin No. 29, pp. 37, illustrated, price 35 cents. 1930.*

This bulletin represents the culmination of a weevil control study initiated in 1919 on the Eli Whitney Forest. The scope of this project is rather local since the work was confined to the immediate vicinity of New Haven, Conn. However, the results are substantiated by somewhat similar studies elsewhere and are unquestionably applicable to plantations throughout the Northeast.

A copious but timely introduction explains the importance of white pine to forest management in the northeastern states and the desirability for weevil control in this region, together with a brief resume of the factors determining a weevil control policy for the white

pine plantations of the Eli Whitney Forest.

The substance matter has been logically divided into three broad headings; (1) The nature and results of the attack, (2) the method of control work and (3) the results of control work.

The first succinctly covers the life history of the white pine weevil, together with the indications of attack and the age at which plantations are most susceptible. The loss of height growth in weevil attack trees and the deleterious effect of such attacks upon the quality of lumber produced is made clear. When growing in dense stands and on the better sites trees readily recover from attack and quickly outgrow the crook made when a lateral replaces the killed leader.

Control consists of removing and burning the weeviled tips before the larvae emerge, thus reducing the number of attacks in subsequent years. This is called the mechanical method of control. The policy is to remove all infested tips until such a time as the stand begins to close, generally at 12 to 14 years of age. If control is continued beyond this period costs mount rapidly, also attacks are less destructive when made after the stand has closed. The object of control is to provide enough suitable stems per acre to furnish a well-stocked stand in the final crop, rather than to aid the particular trees attacked.

The author describes the details of control work clearly and comprehensively. Most significant was the economy of a three man crew, the selection of a central spot for burning, and the proper season for cutting the infested leaders.

The results of control work were studies through a comparison of treated and partially treated stands. The trees on representative plots were tallied by crown classes and as non-weeviled, slightly weeviled, or seriously weeviled; also the number of acceptable stems. These plots were grouped into three site classes and the data tabulated. The treated stands were found to contain a higher number of desirable stems, also the better the site the greater the number of desirable stems. Site has a very important influence upon the damage since it determines the number of attacks possible before the stands close, the rate of recovery from attack and number of whorls destroyed by the attack.

Observations made upon the Eli Whitney Forest indicate that the removal of weeviled tips brings a reduction in the number of subsequent attacks.

The cost depends upon the number of tips removed, the density of stocking and the height of the trees treated. The average total cost for complete treatment is $5.00 per acre. Broadly, the annual cost is 60 cents per acre and the stand must generally be treated for 8 years.

The author concludes that the removel of weeviled tips reduces the amount of subsequent infestation, and on the good and medium sites insures a sufficient number of acceptable stems for the final crop. This is not true for the poor sites and other species should be planted here.

W. H. Bolles,
Pacific Northwest Forest Experiment Station.

Management of Woodlands in Louisiana. By G. D. Marckworth and R. Moore. *Bul. No. 209 Louisiana Exp. Sta. 1930.*

The text is written in simple easy style, intended for the farmer and other small timberland owner. Parts of Louisiana are held in the ownership of large lumber companies, others in vast fields of sugar cane and rice, and a third division has many tracts of timberland in the hands of small farmers. On these farms timber has been a source of considerable ready cash income. As the authors state, the farms contain large areas of land not adopted to profitable farming for ordinary crops. Timber growing offers a profitable use for such lands.

Loblolly and shortleaf pines are given as the species best adapted to the farms, particularly the latter. These two pines are adaptable to various soils and produce timber that has increasing uses. "This insures competitive markets which tend to raise the local prices offered for the products of the farm woodland." Slash pine is rightfully omitted because in the "toe" section of the State—the extreme western extension of the slash pine range—it occurs mostly on low flat lands, outside the farming areas in the hilly lands.

Yields are given for mixed loblolly and shortleaf pine because that is the prevailing type. The yields are for stands from 20 to 70 years old, on three grades of "sites," and in board feet, by both the International one-quarter-inch Rule and the Doyle Rule, and also in cords. It is not stated whether the cords are rough or peeled wood. It may be assumed that the cords are standard cords, although pulpwood in the South is often sold by long cords. For popular reading by farmers the column-heading "site" is unfortunate, when their own words, "land" or "soil," are close enough in meaning and much better for the purpose. However, the authors explain the word "site" in the text preceding the tables. The yields are not for normal or fully stocked stands but "are based on average conditions as found in the 100 sample plots scattered over the State." This should make them usable in a very practical kind of way. However, normal yields furnish probably the best known standard, but they are rare in occurrence in the average farm woods or elsewhere.

Profitable practices for the management of farm woodlands are summed up in stopping the pernicious practice of burning over the woods. The plowing of fire "lines" around a property is described as a means of protection.

Are there not other practices than fire prevention making for profitable woods management? If so, no others are given under the heading, "Profitable Practices." A slight discrepancy occurs in the coördination of headings, as the next main heading "Obtaining the Stand," embodies practices in good management, such as methods of establishing stands, improving them by thinning, and also by cleanings and cutting for use or the market. A general minimum diameter limit for cutting sound thrifty trees, such for example as 12 to 14 inches, might well have been included, as well as the advantages of selectively cutting and leaving a good growing stock as the capital in the

woods bank. The average farmer will unlikely get the most continuous profit by leaving only two seed trees per acre and cutting to the 8-inch diameter limit, as set forth in the example of the Morehouse Parish farmer.

Six essential points are specified under the heading "Marketing": Mark all trees to be cut, obtain from different buyers prices and specifications, select the best market, use a written timber sale agreement, cut and haul your own rough timber products, and insist on the use of a fair rule for measuring the timber.

Well selected photographs or line drawings would have helped in easy reading and using the bulletin.

W. R. Mattoon,
U. S. Forest Service.

Societe Norwegienne De Credit Pour L'Agriculture Et La Sylviculture. (Norwegian Agricultural and Forestry Credit Society.) By Frois Froisland, Director, Oslo, Norway. *Actes Du l er Congrès International De Sylviculture, Vol. III, pp. 296-302, Rome, April 29-May 5, 1926.*

The aim of the Norwegian Forest Credit Society is to supply fixed long time loans to agricultural and forestry enterprise. The borrowers are organized into an association, their properties securing the Society obligations, issued chiefly in the form of mortgage bonds.

The strength of the association lies in the mutual responsibility of the borrowers to repay the loans employed to advance their economic interests. In this it differs entirely from joint stock and state mortgage banks, the latter being organized by the state to make loans direct to the borrower.

The system is further characterized by the fact that the bonds are issued and sold serially in accordance with the needs for capital for the settlement of debts. The state has no part in the organization other than ordinary legal control, the members themselves fixing the terms of the loans. Thus flexibility and adaptation to current changes are assured.

Although the system was first organized in Germany its highest development has been in Denmark, where the societies now represent a loan capital of about $810,000,000. Loans are paid by the sale of bonds of the society on the open market at the best rates obtainable. The Danish bonds are recognized as having international exchange value and large amounts (nearly $2,750,000) can be disposed of daily on the Copenhagen stock exchange, finding such buyers as savings banks, trust foundations, and public institutions. While the need for commercial credit in Norway has been met largely by the Norwegian Mortgage Bank since 1850 its policy of limiting loans to a maximum of $6,750 has not been fully satisfactory. A law passed in 1907 allowed the formation of the present credit society but it was not organized until 1915.

The liability of the individual member cannot exceed the balance of his loan account plus an additional two-thirds. This supplementary responsibility is assured by the pledge of each

member just as the loan itself is pledged. Experience has shown that no excessive risk attaches thereto and that it has furthered the sale of the bonds by assuring the safety of the investment. In its ten years of existence the Society has not had a single loss.

Loans may be made only on operating, inhabited farms and on woodlands. Sawmills and similar local enterprises receive little consideration.

The maintenance of the growing stock is assured by local royal decrees, or, in their absence, by the Minimum Diameter Law of June 7, 1916. This prevents depreciation in the value of the security, which is based on that portion of the stand which must remain intact. In this way good control over the members is assured by the Society.

Another protection against depreciation is the required insurance against fire of forest areas over a certain size.

Only the farm as a unit may be mortgaged in Norway whereas in Denmark submortgages upon livestock, etc., may be taken, while in Sweden on the other extreme, only the ground itself may be mortgaged irrespective of what is upon it.

The appraisals for loans are made personally by specially qualified experts; the society has a chief tax expert who assists the local appraisors and in certain cases makes his own appraisals. The valuation surveys are very detailed in the case of forest tracts over 300 hectares. In order to insure impartial appraisals, the borrower in question is not informed of the results which are reported confidentially direct to the central society.

In making the valuation the average net return from the property should be considered. The capitalized value of this income should show the financial worth of the tract for exploitation. It is necessary that a low value be given so that there will be a safe margin of collateral. Thus the Society will be of aid to proprietors able to furnish satisfactory security and at the same time be well protected.

Loans are based on 60 per cent of the assessment on cultivated fields and insured forest tracts, and 40 per cent of the assessment on buildings. Loans on noninsured timber are based on 30 per cent of the assessment; upon industrial enterprise forming part of the unit, 20 per cent. Otherwise there is no limit to the amount which can be loaned.

Loans may be first mortgages or may be made on collateral deposited with the state treasury, public institutions and trusts, and various banks, in which case the communal approval is required, in view of the prior interests of the commune in its domain. This is due to the fact that the above institutons lend on a higher value of the security than does the credit society.

The loan of the Society is not terminable by it, whereas the borrower may at any time pay extra installments or liquidate the loan entirely. Payments are made over a period of 33 years, in equal semi-annual installments. At 5 per cent interest the semi-annual rate is 3.18 per cent of the first installment on the loan; at 6 per cent it is 3.57 per cent.

The question of interest is very important. Two different views exist among the credit societies. One is that the bond rate should approximate the

market rate as closely as possible, the bonds being sold close to par value. The other favors a low bond rate so that the loans may be obtained more cheaply. This means, of course, that the discount on the bonds will be greater.

The two views have their pros and cons. The danger of the high bond rate is that the market rate may fall over the long period of payment and thus cause a loss to the borrowers who otherwise would have been able to obtain loans at cheaper rates because of the solid value of their security.

The nominal interest rate on loans of the National Credit Society has been 5 per cent until the last two months. The actual market rate of 6 per cent has brought about such an important decrease in the market price of the bonds that a new series at 6 per cent has been opened along side of the 5 per cent issue. The borrowers can therefore choose between the two different types of loan. It is believed that most prefer the 6 per cent type. At this rate the bonds sell at 98, while at the 5 per cent rate they sell at 87. As previously indicated the borrowers can either take the loans themselves at the same rate or secure them through the Society at whatever rate is obtainable at the time of the transaction. In general they prefer the last method. It has therefore been very important at this time for the Society and the borrowers to increase as much as possible the marketability of the bonds; since the supply is increased the market must be extended.

The obligations have a first class investment value, being quoted daily on the Oslo stock exchange. They are legal for investment by trustees holding money for minors, by public foundations, and for purchase by savings and private banks for their reserve funds. To date $7,020,000 of bonds have been sold, and about the same amount paid out in 1800 loans used chiefly for bringing new areas into cultivation. The reserve funds of the Society have increased to $205,000. Considering its recent development and the small size of the country the foundation of the Society has been justified.

Because the system is relatively new, slow and cautious development is essential. Otherwise, the granting of large loans at this time would lead to losses during periods of depression. The Society has tried always to put its loans on a solid foundation (regardless of a demand for uneconomic loans). The sum loaned is divided into a relatively large number of small risks throughout the country. Loans average about 30 per cent of the valuation of the security and should therefore be fully secured even in bad years.

The organization of the Society is broadly modeled after one in Finland. Local credit groups are created whose members (at least 15) are reciprocally responsible for the credit of their group. The value of the credit combined and for each debtor individually is fixed by the group itself with the approval of the central body constituted under the title "The Central Bank for Peasant Credit." This obtains the loan capital for the groups.

The above shows the large development of the agricultural and forestry credit system in Norway. While it is still new, it is hoped that it will procure for agriculture and for forestry the

capital necessary for rational management and in that way act as a powerful lever aiding the country to support itself.

One cannot venture to say how much value a similar system would have in stabilizing farm forestry practices in the United States. Evidently more control over woodland operations would be required than is now the case. Clearly any form of public control would be impracticable for such a purpose. But is there any fundamental reason why an association could not legally bind each member to maintain a minimum merchantable volume of timber while the loan was in force? This aspect merits careful attention as a possible practicable means of facilitating the extension of long term credit to woodland owners. A further thought may be in point. Would a group of woodland tracts listed under a forest crop law such as exists in several states of the United States be a reasonably safe risk?

BERNARD FRANK,
U. S. Forest Service.

EDITOR'S NOTE: The question of forest credits deserves more attention than it has been given. The many financial studies of farm operations have apparently given no consideration to the likely loan value of the woodland. The paper, here reviewed, was read at the First International Forestry Congress in Rome in 1926. Since it apparently has not come to the attention of many timberland owners and foresters, its review at this late date may not be considered untimely.

Generalizations of the Normal Curve of Error. By Luis R. Salvosa. *Edwards Brothers, Inc., Ann Arbor, Michigan. pp. 187. $1.50.*

During recent years, investigators in all scientific fields have been seriously handicapped by the failure of the normal curve of error to represent satisfactorily commonly-found quantitative distributions. In several phases of forestry, investigators have been forced to make generalizations upon noticeably skewed distributions, and, while realizing that the generalizations so made were subject to appreciable error, were unable to make proper corrections for the influence of skewness.

Mr. Salvosa has prepared three sets of tables based upon Karl Pearson's Type III curve. The equation of this curve is:

$$y = y_0 \left(1 + \frac{a_3}{2} t\right)^{\frac{4}{a_3^2} - 1} e^{\frac{-2}{a_3} t}$$

In this equation a_3, t, and y_0 have the following values:

$$t = \frac{x - rp}{\sqrt{rpq}}$$

$$a_3 = \frac{q - p}{\sqrt{rpq}}$$

$a_3 =$ skewness coefficient.

$p =$ probability that an event will happen in a single trial.

$q = 1 - p =$ the probability that it will fail.

$r =$ total number of trials.

$$y_0 = \frac{1}{\sqrt{2\pi}} e^{-\frac{a_3^2}{48} + \frac{a_3^6}{23040} - \frac{a_3^{10}}{1290240} + }$$

When $a_3 = 0$, y_0 becomes $\frac{1}{\sqrt{2\pi}}$ and Pearson's Type III curve becomes the well-known normal curve of error.

The first set of tables presents the areas beneath the standard Type III curve for values of a_3, ranging from 0 to 1.1, and for values of t ranging from —4.89 to 9.51. The second set of tables shows height of ordinates of the standard Type III curve for values of a_3 ranging from 0 to 1.1, and for values of t varying from —5.21 to 9.81. The intervals for these two sets of tables are $\frac{1}{10}$ for a_3 and $\frac{1}{100}$ for t, and the tabular values are given to six places of accuracy.

The use of these two sets of tables assumes that a distribution is completely expressed by the mean, standard deviation and skewness. The error introduced by this assumption probably does not exceed one-tenth of one per cent.

As an example of the application of the first table, a sample analysis of the weights of 10,701 tubercular recruits showed a mean weight of 130.44 pounds, a standard deviation of 43.04 pounds and a skewness (a_3) of 0.58.

The mean and standard deviation were computed in the usual manner, and a_3 was calculated by the following formula:

$$a_3 = \frac{\frac{\epsilon x^3}{n} - 3\left(\frac{\epsilon x^2}{n}\right)\left(\frac{\epsilon x}{n}\right) + 2\left(\frac{\epsilon x}{n}\right)^3}{\text{S.D.}^3}$$

$x =$ weight of any recruit

$n =$ total number of recruits (10,701)

ϵ=Greek symbol indicating "sum of"

S.D. = standard deviation

If this distribution accurately pictures the weights of tubercular males, the percentage of these persons weighing more or less than a given amount can be read from Mr. Salvosa's tables in the following manner:

To find the percentage of tubercular males weighing 161.5 pounds or more,

$$t = \frac{161.5 - 130.44}{43.04} = .7217$$

Table 1 shows that the percentage of area lying to the left of $t = .72$ and under the standard Type III curve for skewness 0.6 (interpolated value for $a_3 = .58$ could have been calculated) is 0.780056. Therefore, the area lying to the right of this value for t is 1.00-.780056 or 0.219944 or approximately 22 per cent. By the theory of probability, and assuming that Pearson's Type III curve fits this distribution of weights, approximately 22 per cent of all tubercular males should weigh 161.5 pounds or more. The normal curve of error gives a probability of 0.235762 for the same weight limit. In this instance the influence of the skewness (a_3 = 0.6) causes a variation of more than 1.5 per cent.

The third set of tables gives for very precise work the derivatives of the standardized Type III function.

In addition to the tables Mr. Salvosa has presented a synopsis of the theory involved in the construction of the tables and illustrative examples showing their application. This volume of statistical tables should be helpful to those foresters who are working on problems involving the theory of probability and sampling.

ROBERT K. WINTERS,
*Southern Forest Experiment Station,
New Orleans, La.*

Vertebrate Natural History of a Section of Northern California through the Lassen Peak Region. By Joseph Grinnell, Joseph Dixon, and Jean M. Linsdale. *Museum of Vertebrate Zoölogy, University of California. Pub. by University of California Press, Berkeley, Calif. P. 594, Figs. 181. 1930.*

This is the most recent of a series of reports or monographs on the natural history of limited regions in the State of California. The work is restricted principally to the terrestrial vertebrates—amphibians, reptiles, birds, and mammals. The region covered in this report is a 24-mile-wide strip extending from the Sacramento River eastward for 124 miles over the mountains forming the north end of the Sierra Nevada system to the Nevada line. It embraces nearly 3000 square miles and includes a great variety of environmental conditions from the upper Sonoran zone to the Arctic-Alpine zone—the upper Sacramento valley of less than 300 feet altitude, the grassy foothills, the woodland type, the high altitude (over 10,000 feet) of Mt. Lassen, the pure and mixed forests, high meadows of the region and the dry eastern plains of the Great Basin platform. Although the report is addressed to the student of animal ecology as well as to others specializing in the broad field of vertebrate distribution, it is of interest also to the forester and grazier. Throughout the work there are frequent references bearing on forest ecology and to the influence of lumbering or grazing upon animal life.

All but about 170 of the nearly 600 pages are devoted, naturally, to general accounts of the species of vertebrates of the region. The accounts contain, as a rule, only such data as pertains to these species as residents of the region, and are not complete life histories. They vary in length from a few lines to several pages. For example, for porcupines are given data on localities where they were taken, habitat associations, behavior of the animals found, special feeding habits, and other natural history notes made by the observes that add to the existing knowledge of the species.

The parts concerning distributional considerations (exceedingly well illustrated), life-zones of the region, and faunal relations, are of particular interest to the forester in that they indicate to him some of the relations between forest growth and forest life and how the latter might be altered by cutting the former.

In this day of profound changes in natural environments brought about by the activities of man, studies of this kind have great value in recording conditions as they were under nearly natural conditions or before they were much disturbed. This particular region, however, in certain localities has already suffered large changes through agricultural pursuits, lumbering, grazing, and fire.

Emanuel Fritz,
University of California.

The Distribution and the Mechanical Properties of Alaska Woods. By L. J. Markwardt, U. S.

Forest Products Laboratory. *U. S. Department of Agriculture Technical Bulletin No. 226. Pp. 79. Government Printing Office, Washington, D. C. 1931.*

This bulletin gives useful information concerning the supplies and the properties of the woods of Alaska. Alaska has a forest area of over 70,000,000 acres. The commercial timber belt, however, is much smaller and is restricted largely to the coastal region. Within the two national forests of the region there are estimated to be about 85,000,000,000 board feet of saw timber.

The bulletin brings together a great deal of information on the timbers of Alaska such as forest description, forest types, production, export and yield, species descriptions and properties of the woods. Discussion and data on properties occupy about thirty of the first fifty pages. A twenty-three page appendix gives detailed results of structural timber tests, a brief glossary of terms and a table of working stresses. The work is well illustrated. The data on mechanical properties is based on the usual limited number of tests but the author believes that when properly interpreted the results are a valuable means of appraising the properties and establishing design values. About nine species are considered, of which western hemlock and Sitka spruce are by far the most important. The strength properties of these and the others tested were found to be in close agreement with those of the same woods grown elsewhere in the United States.

The bulletin is quite up to the standard of the publications emanating from the Forest Products Laboratory as to its technical contents. Entirely aside from this, however, one is forced to wonder at the inconsistency of our government in handling national problems. Here is a sizable publication, whose preparation required much time of skilled technicians and which is bound to create the impression that Alaska is awaiting development and that the government is encouraging it. At the same time overdevelopment of resources in the United States proper has developed social and business conditions that are steadily becoming more acute. The paper industry, for example, has been urged to develop the pulpwood resources of Alaska, while at the same time in the United States proper raw materials suitable for pulp are being wasted. One government report decries the wastefulness of the lumber industry, another encourages the development of virgin resources elsewhere, and thus makes it still less possible to do anything with our wastes at home. The species differences and handling problems of course are important factors but certainly not the deciding ones. It would seem that Alaskan resources should be developed to their utmost, as and when the world needs them. To do so prematurely with the energy frequently suggested will help Alaska very little in the end, and weakens the United States proper accordingly. We might profitably cut down our effort to develop Alaska and then begin cutting down some more within our major borders.

E. F.

Bibliographie der Pflanzenschutz-literatur. (Bibliography of the Literature on Plant Protection.) For the year 1929. By Dr. H. Morstatt. *Biologische Reichsanstalt für Land und Forstwirtschaft in Berlin-Dahlem. Paul Parey, Berlin, 1930.*

This bibliography is very valuable to students of forest entomology and forest pathology. For the year 1929 it requires 246 pages, 23 of which are given up to an authors' index. The literature of the world seems to have been carefully gone over to make the bibliography complete. The large number of American authors and titles is noteworthy.

The organization of the titles makes the work very convenient or reference. They are classified according to the organism causing the sickness of the plant —insect, disease, and others—and to the host, and these in turn are further reclassified.

E. F.

CORRESPONDENCE

Editor

JOURNAL OF FORESTRY

SIR: As Editor of the *Quarterly Journal of Forestry*, I have been taken to task by some of my American forester friends for having published an article by the Hon. Nigel A. Orde-Powlett, which, according to your notes on p. 442 of the March number of your JOURNAL, is conspicuous for "its clarity in stating the compound interest fallacy." It is true that the article in certain respects contravenes my own views, but it is well written and I hope that my regular readers have become so imbued with sound economic doctrine that they can be safely exposed to a little error. No editor of a scientific or technical journal is justified in opening his columns to one side of a controversy only.

The compound interest controversy is of long standing and great importance. Those who use compound interest in their computations generally start from bare land, whereas those who refuse to do so start from an existing forest, and it is not at first sight easy to reconcile their views. A great step forward, however, was taken by von Spiegel (*Praktische Waldwertrechnung*, Hannover, 1926), when he worked out the rate of *simple* interest which net income from a normal forest represents on the capital value of the forest (i. e., the value of the land, growing stock, etc.). Using this method, he redetermined the financial rotations for each of the commonest species in Germany, defining as the financial rotation the rotation on which a given value of capital (in the form of normal forest) will yield the highest net income. This method is difficult to work with in practice, but the theory at the back of it is, surely, acceptable to all foresters.

The interesting thing about von Spiegel's results is that the financial rotations determined by his method are identical with those rotations determined by his method are identical with those rotations which yield the highest rate of compound interest starting from bare ground. Also, the rates of simple interest worked out by von Spiegel as being the highest that can be obtained from a normal forest are identical with the rates of compound interest which compound interest calculations demonstrate as obtainable with the same costs of management and timber prices. Since both the methods—one a simple interest method and the other a compound interest method—are sound, they give the same result. The principles involved in this reconciliation are set forth in Chapter XI and on pp. 212-214 of my *"Economics of Forestry"*, (1930).

This should help to solve the compound interest difficulty for all foresters, except those who hold that econom-

ics should be entirely disregarded in forestry; but these may be left to the processes of time and natural selection to eradicate. I do not wish to imply that no forestry should be carried on which does not pay 5 per cent interest, but that we should try to produce timber as cheaply as possible and, since forestry is an industry which requires a large amount of capital, interest on capital is the chief cost. As long as we ignore this consideration, we shall fail to fathom the basic causes of devastation and shall be unable to cure it.

The laws of economics are operative whether we regard them or not. Thus Sweden is favorably situated for the forest industry and it has certainly paid her to maintain her forests intact. M. Jourdain discovered that he had been talking prose all his life without knowing it, but this was no reason for refusing to study the laws of good French.

Very truly yours,

W. E. Hiley,
Imperial Forestry Institute, Oxford.

Editor's Note: The article referred to by Mr. Hiley was inadvertently left out of the March issue when it went to press. It appeared in the April issue.

SOCIETY AFFAIRS

Changes in Journal Contemplated

The Journal is not published in June, July, August and September. Manuscripts intended for publication in the October and later issues should, however, be sent to the Editor without delay rather than held until late in the summer. It is hoped that the October issue can be mailed before schedule to relieve pressure later.

During the summer months the Editor wishes to consider suggestions for changes in the make-up of the Journal. The principal features for which changes are thought desirable and for which suggestions are solicited include the following:

1. The color and kind of paper in the cover. Is the green of the February, 1931, number acceptable?

2. The quality of the paper in the body. The present paper is soft, weak and bulky; however, it is very easy to read and handle. With the increased size of the Journal, 1200 pages in 1930, this paper makes the eight issues of one year so bulky as to increase the cost of binding. Illustrations require special paper at present and must be "tipped in," adding to the cost of using cuts.

3. Double-column versus page-width-column type page. The two-column style makes for easy reading though at a little sacrifice in space.

4. The table of contents. At one time the table was printed on the back, now it appears on the page facing the editorial. In neither case is there room enough for listing the titles of reviews, briefer articles and notes. In November, with a short list of major articles, the reviews and notes were listed in a running style but without author and page reference. Is it desirable to include the titles of reviews, notes, and the like in the table of contents? If so, it will require two pages and may have to be placed at the back.

Readers have expressed a great deal of interest in Journal policy and make-up during the current publication year. This is gratifying to the Editor and he hopes those having suggestions for improvement will submit them for his consideration before a decision must be made on the style of the magazine beginning with the October issue.

Emanuel Fritz,
Editor-in-Chief.

The Editor's Address

Several delays have occurred through improper addressing of material intended for the Editor. The Editor's office is in Berkeley, California, not Washington, D. C. Business matters such as concern reprints, subscriptions

and the like should be sent to the Business Manager in Washington, and not to the Editor.

Resignation of W. R. Hine as Executive Secretary

Executive Secretary Hine has been ill for some time and for the past three months has been undergoing treatment at the Veterans Hospital, Oteen, North Carolina. Unfortunately, his illness will require indefinite hospitalization and for this reason Mr. Hine has resigned as Executive Secretary and the Council has reluctantly accepted his resignation.

During his incumbency Mr. Hine made much of the possibilities of the position, and the Society is today further ahead and more firmly established because of his efforts. There is no question but that his earnest endeavor and conscientious effort tended to wear down his health.

PAUL G. REDINGTON,
President.

Appointment of Franklin W. Reed as Executive Secretary

The Society is very forunate in having secured, in Mr. Hine's stead, the services of Mr. Franklin W. Reed as Executive Secretary.

Mr. Reed is unquestionably one of the best known foresters in the profession. He has been a member of the Society since 1904. His long period of service with the Forest Service, his consulting work, and more recently, his work with the National Lumber Manufacturers Association, all bespeak a versatility that will be of great value to the Society.

Mr. Reed was born in Massachusetts, May 11, 1877. He was graduated from Harvard University 1898 and later attended the Biltmore (N. C.) Forest School where he finished the course and was appointed assistant in the management of the Biltmore Forest. During the summer of 1900 he was one of the party of students who, under Dr. Schenck's guidance made a tour of the European Forests, later going on an independent tour of the forests of Russia, Norway and Sweden. On February 11, 1902 he was appointed Assistant Forest Expert in the Bureau of Forestry and in May, 1902 passed the Civil Service Examination for the position of Field Assistant, to which position he was appointed June 28, 1902, being engaged in making working plans under the Division of Forest Management. During 1904, Mr. Reed was in charge of the party which prepared a working plan for the Kaul Lumber Company of Alabama, a plan which has actually worked and is still being followed by the Company. In July, 1910, he was appointed Associate District Forester in District 4 of the Forest Service at Ogden, Utah. In August, 1911 he returned to the Washington Office as Forest Inspector in the Branch of Operation, which position he resigned December 14, 1913 to accept the appointment of Forester for the Indian Service, Department of the Interior. On July 8, 1914, he reentered the Forest Service as an Assistant Dis-

trict Forester, acting in charge of the new District then being organized, and in June, 1919 he was made District Forester of this District.

In 1924 he left the Forest Service and during 1925 was engaged in private forestry and consulting work with the view of recommending timber growing properties for investment. During 1926 he was with the National Conference on Outdoor Recreation and in 1927 returned to consulting forestry work with Bennedict and Rue. In 1928 he went with the National Lumber Manufacturers Association and comes to the Society from them.

The Society is very desirous of aiding the work of the Timber Conservation Board. There seems to be no reason why we should not participate whole-heartedly in this work and utilize much of the time of the Executive Secretary in this particular project. By doing this, we have a splendid opportunity to bring forestry more prominently into the picture. To this end, a good deal of Mr. Reed's time will be devoted to securing factual information for the National Timber Conservation Board.

PAUL G. REDINGTON,
President.

AMENDMENT TO THE BY-LAWS OF THE SOCIETY

At a meeting of the Council, February 3rd, held in Washington the by-laws of the Society of American Foresters were amended as follows:

Candidates for Associate membership shall be endorsed by at least three sections "as having shown substantial interest in forestry and having participated in its advancement." Section endorsement shall not be perfunctory on the request of another section, but shall be based on knowledge of the applicant or his work.

ELECTION DATE SET

The Committee on Nominations has selected December 14, 1931, as the date of election. Nominations of the Committee, together with those received by petition, will be published in the October issue of the JOURNAL.

It is hoped that the membership and Sections will submit such petitions as are provided for in the Constitution. It should be remembered that under the Hare system of election, nominations are not made for President and Vice-President, as such. Nominations by petitions should be made with the idea that the nominee is suitable material for President and may, in fact, be elected to that office.

Nomination petitions should be in the hands of the Committee not later than July 1st.

WILLIAM L. HALL,
Hot Springs, Ark.
Chairman, Committee on Nominations.

PROCEDURE OF ELECTION TO MEMBERSHIP

All applications for membership in the Society should be sent to the Society office, Suite 810, Hill Bldg., 839 17th Street, N. W., Washington, D. C., where they are checked for section endorsement and qualifications as out-

lined in the Constitution of the Society.

Acknowledgment by letter is sent to the candidate and he is further informed that the procedure of election may take four months. His name is then listed in "Announcement of Candidates" appearing in the next available issue of the JOURNAL. Under the Constitution this is necessary for comments by members of the Society. One month later his application is presented to the Council for vote.

In order to facilitate election the Society office has been submitting applications to the Council before this specified time has elapsed. The notification of election, however, has been withheld until the month is up.

In case of unanimous election the candidate is notified immediately as is the section. Where negative votes appear on the ballot, application papers are forwarded to the Member-in-Charge of Admissions (W. G. Howard) for his decision.

The present estimated average time for handling applications is approximately 3 months. It is significant that this time has been cut down from some 9 months or a year. At best 2 months' time will be required for election under the present constitutional requirements.

L. A. WARREN,
Business Manager.

MEMBERSHIP MANUAL BEING PREPARED

In an effort to speed up the election of members, six copies of membership application papers are typed in the Society office and circulated among the Council members — one set going to each two members geographically nearest each other. This has resulted in a considerable saving of time.

It is apparent, from studying application papers, that candidates usually fail of election because of insufficient evidence. The Council must base its vote in most cases on information given in the application papers. Where insufficient information is given the Council cannot conscientiously declare a candidate eligible. A membership manual for sections is suggested as a possible aid in the preparation of application papers. Other phases of membership will be discussed with the view of facilitating election procedure.

Many of the sections have already indicated their approval of such a manual and it is hoped that it will be available in a short time.

L. A. WARREN,
Business Manager.

WILLIAM H. VON BAYER

1876-1931

William Hector von Bayer, Associate Forester in the Indian Service, died suddenly at his home at Washington, D. C., on March 16, 1931, after an illness of about five weeks characterized by extreme nervousness and mental depression.

Mr. von Bayer was born September 18, 1876, at Washington, his father having been for many years the Chief Engineer for the United States Fish Commission. Upon graduation from the Central High School of Washington

Mr. von Bayer entered Cornell University as a student in the College of Agriculture in September, 1898. He later matriculated in the newly established New York State College of Forestry. When instruction in forestry was temporarily abandoned at Cornell in June, 1903, Mr. von Bayer entered the School of Forestry at Yale University, from which he received a degree as Master of Forestry in June, 1904. He also received the Bachelor of Arts degree from Cornell University. He was employed in the Forest Service of the Department of Agriculture from July 1, 1904, to July 26, 1910, during which period considerable time was spent in the field.

Mr. von Bayer entered the Indian Service on July 27, 1910, by transfer from the Forest Service of the Department of Agriculture, and was continuously engaged in the forestry work of the Indian Service from that time until his untimely demise on March 16, 1931. His work in the Indian Service was chiefly directed to Office administration and during two decades of faithful service he became familiar with the widely diversified phases of Indian administration.

Mr. von Bayer was ever enthusiastic in a maintenance of the fundamental principles of conservation and loyally devoted to the ideals of his chosen profession. Circumstances did not permit of his extensive participation in field investigation or administration, but those engaged in the field work were ever assured of the sympathetic consideration and earnest coöperation of this zealous friend of the field force. He was always deeply interested in the welfare and the advancement of his associates and friends. Not infrequently his efforts to assist others involved him in situations that were embarrassing. However, these experiences did not dampen his ardor for helpfulness and as often as the occasion arose he literally "threw himself" into the exhilarating task of "putting the plan over". While his fervor was not always shared by his friends and associates, all freely acknowledged his earnestness and admired the spirit with which he devoted his every energy to any subject that claimed his interest. He had many admirable qualities that those of us who are more reserved might profitably imitate.

On June 13, 1912, Mr. von Bayer married Greta Lorleberg a talented pianist, educated at Hanover and Berlin, Germany, who survives him.

J. P. Kinney,
Chief Forester, U. S. Indian Service.

Allegheny Section Suggests Change in Election of Society Officers

At its annual meeting, February 27-28, the Allegheny Section passed the following resolution and circulated it to all regional Sections for consideration.

Whereas, The continued progress of forestry in the United States demands a strong professional organization, and

Whereas, The strength of any organization depends upon the interest and active participation in its affairs by all members, and

Whereas, The majority of the mem-

bers of the Society of American Foresters have little opportunity for direct contact or active participation in the affairs of the Society, except through the Sectional organization of their regions, and

Whereas, As a result of this situation, the several Sections of the Society are becoming units wherein closely associated foresters with more or less common regional problems are best able to make direct contacts and secure real results, and

Whereas, Any decisive action on the part of a Section is now severely handicapped because of the fact that no provision is made for Sectional representation, as such, in the affairs of the Society, either at annual meetings or on the Executive Council, and

Whereas, Direct representation for Sectional units is advocated as a sound fundamental principle of democratic government, and would afford each group of members far more satisfactory representation than does the present system of election, whereby the Council necessarily consists of those members best known throughout the nation, generally because of their affiliation with some national organization, now therefore be it

Resolved, That the membership of the Allegheny Section assembled at Harrisburg at the annual meeting of February 28, 1931, favors a change of procedure in the election of members of the Executive Council of the Society, whereby there shall be one representative elected by each of the several Sections of the Society, and each Council member's vote be counted in proportion to the numerical membership of the Section he represents, and be it further

Resolved, That copies of this resolution be sent to each of the Society Sections, as well as to all members of the Executive Council, with the request for consideration and action.

At its annual meeting on March 13, 1931, at New Orleans, the Gulf States Section approved a resolution "that we favor having each Section represented on the Executive Council by one member, but that each Council member have equal voting power" in support of the suggestion of the Allegheny Section.

New England Section Discusses Important Subjects

The winter meeting of the New England Section was held at the Narragansett Hotel, Providence, R. I., on February 23 and 24, with an attendance of over 80. Various committee reports were heard and the following are being mimeographed and distributed to the section members: Stabilization of the Lumber Industry, R. C. Bryant; Cooperative Control of Private Forests, C. R. Tillotson; Acquisition of Public Forests, R. M. Ross; Markets, E. C. Hirst; Stand Improvement (Girdling to Release Merchantable-Sized Spruce and Fir), M. Westveld. Mr. N. W. Hosley's report on Wild Animal Damage has been submitted to the Journal of Forestry for publication. An illustrated talk based on studies of the decadence of birch in northern New England by P. Spaulding and H. J. MacAloney was given by the former, and a paper entitled "A Natural Site Quality Classifi-

cation for Pure White Pine Stands" was read by J. G. Falconer, Yale School of Forestry. In addition, Mr. W. E. Hiley, of the Imperial Forestry Institute at Oxford, gave a most interesting address on forestry in the British Isles, and Dean H. P. Baker, of the New York State College of Forestry, spoke briefly on the changes which have taken place in forestry in the past ten years.

All the committees have been continued and a new one, composed of Mr. E. C. Hirst and Prof. R. C. Bryant, was appointed to coöperate with the New England Council, or other interested agencies, in planning a conference of producers and consumers with the aim of improving conditions in the lumber industry in New England.

C. R. Tillotson proposed the following resolution which was adopted and ordered to be sent to the governors of the New England States: "In accordance with Ex-President Coolidge's sentiments as expressed recently in the press concerning the use of unemployed men in forestry operations on state and national forests, be it resolved that the New England Section of the Society of American Foresters approves heartily of such measures, commends the Governors and legislatures of the region who have made funds in excess of regular appropriations available for such purposes, and urges similar action by other states."

Mr. A. F. Hawes, Connecticut, was reëlected Chairman, and Dr. H. J. MacAloney, Massachusetts, was elected to succeed Mr. A. C. Cline. Mr. A. W. Hurford, Rhode Island, and Mr. J. E. Scott, New Hampshire, were elected to the Executive Council for a term of three years.

H. J. MacAloney,
Secretary, New England Section.

New York Section Holds Well Attended Winter Meeting

The annual winter meeting of the New York Section of the Society of American Foresters was held at Albany, February 6, 1931. About 74 members were present. Visitors included President Paul G. Redington, of the parent Society; Dr. Joseph Illick, of the Allegheny Section; R. E. Marsh, of the Washington Section; C. E. Behre and Marinus Westveld, of the New England Section.

Reports on membership showed an eligible list for membership of 171 men. During the past year 18 new members had been added by election and 13 new members by transfer from other Sections. Against this there have been losses of 7 members by transfer out of the State and 2 members have been lost through death.

Technical papers were read by Charles E. Baker on "Reforestation under the Hewitt Program," by J. A. Cope and J. Nelson Spaeth on "The Elimination of Weed Species with Sodium Arsenite," and by Stuart S. Hunt on "A Preliminary Report on Plantations in New York State".

The evening session of the meeting took the form of an informal dinner with addresses by Dr. C. E. Ladd, Deputy Commissioner of Conservation in New York State; Mr. Paul G. Reding-

ton, President of the parent Society, and Dr. Hugh P. Baker.

The officers elected for the coming year are: *Chairman*, A. S. Hopkins; *Secretary*, H. C. Belyea; *Members of the Executive Committee*, S. N. Spring, C. E. Boyce, P. T. Winslow and J. E. Keib.

ALLEGHENY SECTION MEETS; HAS GOOD PROGRAM

The Allegheny Section of the Society of American Foresters held its 10th annual meeting at Harrisburg, Pennsylvania, on February 27 and 28, 1931. It was by far the best attended meeting ever held by the section as an even 100 were registered.

The opening session was called to order by Chairman G. H. Wirt, at 1:30 P. M. in the Senate Caucus Room of the State Capitol. The Honorable Gifford Pinchot was present and extended a few words of greeting. The following papers were presented:

The Pennsylvania Forest Research Institute, by W. M. Baker; A Review of Forestry Literature, by A. C. McIntyre; Forest Fire Protection in the Southern Portion of West Virginia, by C. H. Tracy; The Need for Forest Influences Study in the Allegheny Territory, by R. D. Forbes; Pumps Used Effectively in Controlling a Ground Fire, by K. J. Seigworth; Local Economic Influences of National Forests, by L. L. Bishop; Increment of Mixed and Pure Forest Stands, by G. S. Perry.

The parent Society was represented by its Business Manager, Miss L. A. Warren, who, through her ready wit and clever repartee, proved a capable substitute for President Redington, who was unable to attend, and left no doubt in the minds of the members that the business affairs of the Society are being well handled.

The Saturday morning session was devoted to a review of the past year and Sectional business. Heads of the several state forest services and other forestry organizations were called upon for five-minute talks. The following responded: J. A. Ferguson, F. W. Besley, N. T. Kessler, Chapin Jones, W. S. Taber, H. S. Newins, O. M. Wood.

The following Committee Reports were presented and approved:

Reforestation, Chairman, N. T. Kessler; Forest Practice, Chairman, C. R. Meek; Forest Types, Chairman, R. D. Forbes; Railroad Fires, Chairman, H. B. Rowland.

The Secretary read a resolution of regret at the untimely death of Clarence Russell Anderson, one of the founders of the Section, which was unanimously adopted.

The Secretary also read a resolution seeking to change the procedure of election of members of the Executive Council, whereby each Section would elect one representative. It was adopted after considerable discussion.

The following officers were elected for the coming year: Chairman, R. D. Forbes, Allegheny Forest Experiment Station; Vice-Chairman, H. S. Newins, State Forester, West Virginia; Secretary-Treasurer, H. F. Round, Pennsylvania Railroad.

H. F. ROUND,
Secretary, Allegheny Section.

Washington Section Discusses Erosion Control

The first meeting of the Washington Section since the annual meeting of the parent Society during the holidays was held on February 5, 1931, at the Cosmos Club.

E. A. Sherman advanced "A Plan of Action on the Erosion Problem." He told of a study of forest land damage in the Mississippi drainage basin following the 1927 flood. The forest land situation, while unsatisfactory, was completely overshadowed by the enormous damage to agricultural land. This damage was not limited to the land actually flooded. The 1,225,000 square miles of land forming the Mississippi watershed suffered greater damage from soil erosion than the flooded 18,000 square miles suffered from inundation. The Lake States Forest Experiment Station found that the southwestern part of Wisconsin is a region of serious damage. Mr. Sherman cited an example of a half-section of agricultural land in this region which depreciated materially in value as the result of erosion occurring between 1921 and 1928. It is often suggested that the federal government should acquire such land for national forests, but this is a weak argument because the land is not forest land but mismanaged agricultural land.

Mr. Sherman compared the soil erosion problems with the forest fire control problem before the Weeks Law was enacted. The technique of soil erosion control is much simpler and much more advanced now than was that of fire control at that time. Land in both cases is largely in private ownership, and likewise the cause of the damage may originate on the land of other owners, therefore the same interrelations occur in the erosion control problem. There is the same point of federal responsibility in both problems, although this is probably more direct in the case of erosion and flood control because the silt clogs up the waterways over which the federal government has direct control. The Weeks Law will be successful in forest fire control if it can be extended to all forest land. Mr. Sherman stated that the same plan of organization and the same principles of coöperation can be applied to the control of soil erosion. Such an erosion control law should not be administered by the Forest Service, although there would have to be some forestry in it. It is rural engineering and belongs under the Secretary of Agriculture. Mr. Sherman believes that five million dollars spent annually under authority similar to that of the Weeks Law, could work wonders with this problem. The farmer, properly guided in the engineering phases, he believes, would take hold of this control work. Unlike fire control, erosion control pays immediate and annual dividends. It can be applied right on the land and not downstream by the building of dikes and dams.

Mr. Sherman said that Bates found a tremendous amount of silt in the streams entering the Mississippi between the foot of Lake Pepin and Rock Island, Illinois, and had expressed the belief that this can be corrected for a million dollars to be expended for a thousand dams at an average cost of a thousand dollars each. Mr. Sherman believes that it would take more dams than that, and that many of them could be built for only a few dollars apiece.

The problem can be whipped piecemeal. Treating land by leveling so as to hold the rain that actually falls on it, will remove that much land from the problem. Twenty years with five million dollars annual appropriation would totally transform the Mississippi Valley. There would still be need for levees, but these would offer adequate protection and spillways would not be necessary. After the twenty years, of course, some work would have to be continued.

Considerable discussion was precipitated by Mr. Sherman's talk. Wheeler stated that officials of the Oklahoma A. & M. College had informed him of the rate of erosion damage in that state. Of the 44 million acres land area of Oklahoma, 16 million acres have been tilled. Since Oklahoma has been farmed 1.2 million acres have been eroded to the point of being no longer useful for cultivation. The rate at which this agricultural land is being destroyed is now 0.2 million acres a year. In 35 or 40 years it is estimated that 13 of the 16 million acres of agricultural land will have been destroyed.

In answer to a question by Major Stuart, Sherman stated that it would not be a hopeless task to completely prevent erosion. In our modern mechanical age we have acquired the power to move soil by machinery, which permits leveling and perhaps diking so as to hold every bit of the rainfall we get. An additional inch or two of rain means much in the more arid regions. In the rainy regions the time will come when the same efforts will be made to hold the rain as in the arid regions. Contour plowing cuts down erosion, but leveling can stop it completely.

Mr. Sherman answered the question of why the eroded half section in Wisconsin that he referred to in his talk, had not been damaged prior to 1921. He stated that the land had been cleared after the Civil War and produced great crops for 60 years. Sheet erosion took place during those years, until the two-foot surface layer of black soil was thinned to a few inches. As soon as the erosion forces cut through this top layer into the underlying deposit of loess soil erosion rapidly gullied down as much as fifty feet, most of this damage occurring since 1921.

Butler said he believed that forestry had a bigger part in erosion control than estimated by Sherman, and asked if the states would not have more trouble meeting federal coöperation because the land owner would not expend any funds. Mr. Sherman replied that it should be easier, for the land owner would match his labor and that of his teams against federal funds. The farmer needs only engineering leadership.

Major Ahern told of the high degree of erosion control secured by the head-hunting tribes on the steep slopes in the rainy region of the Philippines. There, control was accomplished without forestry and by ignorant natives.

Dr. George Fields, upon invitation of the Chairman, made brief comments. He stated that the proper function of the Department of Agriculture was to make the farmers conscious of the value of water. The farmer now sees its value for waterpower, accumulated in reservoirs, but where he needs water most is on his land.

A. E. Fivaz,
Secretary-Treasurer,
Washington Section.

Ozark Section Meets

At a meeting on January 29 at Hot Springs, Arkansas, ten of the twenty-five members of the Ozark Section of the Society were present. Officers elected are George R. Phillips, State Forester, *Chairman;* A. C. Shaw, Forest Supervisor, *Vice-Chairman;* Charles A. Gillett, Extension Forester, *Secretary.* A general meeting and field trip are being planned for a date in May or June. The Section will make an effort to interest the seventeen eligible non-members of the region to join the Society.

Gulf States Section Has Annual Meeting

The annual meeting of the Gulf States Section of the Society of American Foresters was held March 13 and 14 in New Orleans with an attendance of about 30 foresters.

A wide variety of subjects was presented and discussed in the Section's symposium. P. C. Wakely delivered a paper on "Southern Pine Seed" in which he gave some of the results of his seven years of experimental work with seeds. With the many anomalies in connection with the production of southern pine seed many of the present general ideas about seed are found to be untrue. For instance, it is the general belief that longleaf produces seed once in seven years, whereas records show that in some large areas longleaf seed has been produced abundantly in each of two or three successive years, and generally much more often than once in seven years.

"Spruce Pine, A Little Known Southern Pine" was presented by McKiethen and St. Dizier. Although at present spruce pine is of practically no importance, it is believed that this fast growing species could be grown successfully in plantations for pulpwood. Its lumber is sometimes sold as "southern white pine."

G. H. Lentz gave a synopsis of the work to be done in making the forest survey of the southern hardwood region in his paper, "Plans and Methods of the Hardwood Survey." The hardwood situation is very complex and less is known of the possibilities of the hardwoods than any other group of species. This situation is recognized in pushing the government's forest survey into the southern hardwoods as the second regional study. When the survey has been completed we will have the facts concerning the amount, occurrence, rate of growth, and the rate of depletion of the bottomland hardwoods, and there will no longer be the need of extensive estimates based on inadequate data.

Mr. Stuart Moir of the Fairchild Aerial Survey, Inc., in his talk, "Possibilities and Application of Aerial Cruises to Southern Species," showed that, supplemented by a small amount of ground work, aerial photography is an excellent means of obtaining an accurate forest map and cruise of the timber stand.

R. M. Lindgren presented a paper on "Sap-stain of Lumber and Logs and its Prevention." Encouraging results have been obtained recently with chemical treatment applied as lumber dips and log sprays. The treatments discovered are far superior to the current practice

of soda dipping on pine and are much cheaper than present methods of handling hardwood lumber for stain prevention.

Interesting facts about erosion were given by J. D. Sinclair in his paper "Studies of Soil Erosion in Mississippi." An instance was cited where soil which was washed from the denuded hill lands formed a deposit three to six feet on a fine tract of bottomland and killed a stand of hardwood timber worth $50 per acre. Unchecked erosion is destroying the bottomlands as well as the hills.

S. W. Greene, in charge of the cattle grazing experimental work at the Coastal Plain Experiment Station, McNeill, Mississippi, told how the land owner could operate a combined project of forestry and cattle grazing on the same land. By paying the current expenses such as taxes and protection costs with the annual grazing income, the project may be carried for the long period of time required to grow the timber without the costs becoming prohibitive.

The income that would be possible from growing longleaf pine on sites similar to those at McNeill was described by W. E. Bond. Longleaf turpentined at 30 years and cut for lumber at 48 years was shown to yield an average annual income of 55 cents per acre after all costs have been paid. This income is equivalent to an earning of 9 per cent with compound interest on the initial investment of $6.00 per year. It may be increased by properly controlled grazing in certain stages of development as pointed out by Mr. Greene.

A. R. Spillers,
Secretary, Gulf States Section.

Arkansas Holds Well Attended Forest Extension School

The first Arkansas Extension School of Forestry was held at Pine Bluff, Arkansas, on December 11 and 12, 1930. The purpose of this meeting was to bring together the many different groups interested in some phase of forestry to a common ground of understanding. The farmer should know the lumberman's problems, the lumbermen should know the farmer's problems, the business men connected with lumber-using concerns should know the problems of both. Opportunities were offered to discuss many problems of interest to all.

Approximately 250 attended including foresters, saw mill men, rangers, fire wardens, officials of wood-using concerns, business men, county agents, school teachers, county officials, state legislators, and others.

The program lasted two days with a night session the first day. Sixteen papers were presented which gave very clearly problems of nation-wide and state-wide importance. Excellent papers were presented by Dr. E. A. Ziegler of the Southern Forest Experiment Station; Howard J. Eberly, District Forest Inspector, New Orleans; R. H. Wheeler, Chief Forestry Lecturer, U. S. Forest Service; Guy Amsler, Arkansas Fish and Game Commissioner; R. P. Bowen, Secretary of Chamber of Commerce, Malvern, Arkansas; and Pete Cole, Agricultural Commissioner, Cottonbelt Railroad. Several excellent papers were also presented by farmers residing in various sections of the state.

The success of this first attempt by the Extension Service of the College of

Agriculture of the University of Arkansas to hold a state-wide forestry school of this nature warrants another meeting sometime during the winter months of 1931.

CHARLES A. GILLETT,
Extension Forester.

Objectives in Handling Federal Forest Lands Discussed by Wolff

At the January 19, 1931, meeting of the Northern Rocky Mountain Section, Mr. M. H. Wolff, Assistant Regional Forester, made a splendid and concise presentation, prefacing his views with the statement that, in his judgment, the policy, in order to be sound fundamentally, must consider "federal" as of first importance, "land" second, and "forest" third. He pointed out the natural tendency of foresters to place "forest" first.

When one thinks of "federal" he contemplates that it is of the people of the country; hence is akin to the object of government. It is the object of a democratic government to benefit the people. One of its chief purposes is to do for the people what individually we are unable to do at all or cannot do as well. He emphasized that by government there is not meant its separate agencies, since it is not for their benefit that federal lands are handled.

Inasmuch as the property under consideration is land, forestry is only one of the kinds of beneficial management to which the land in question may be susceptible. He pointed out that just because land is in forest or is of high timber-producing power, does not necessarily mean that forest production is its principal use. The concept that the handling of federal forest land should have to do mainly with the production and utilization of timber is erroneous. Wolff believes that the property is land primarily, and not necessarily forest land permanently, and that a sound federal forest-land policy must consider land use in which all phases of forestry are only a part and in some instances may not even have a place.

Wolff takes the position that since the forest lands in question belong to the whole people, the objectives of a federal policy in handling such lands are first, *service*, irrespective of financial returns. He pointed out, however, that the cost of rendering the service must be considered from two angles. First, is the service worth the cost? Secondly, is the service being rendered at the maximum possible efficiency?

In Wolff's view, service in the handling of federal forest lands means constantly engaging in nonprofit-making enterprises and putting financial profits as incidental. Consequently, one cannot be sure that national forests will ever be financially self-sustaining. It is idle to talk about profits from national forests if one has in mind only financial returns, or for the administrator of such a forest to set as a goal the making of his forest self-sustaining financially, as that is commonly interpreted.

Wolff then gave the following objectives in the handling of federal forest lands: In the first group, (1) Land classification, with a view to determining the manner in which these lands may be of principal service. For example,

whether they should be farmed or handled primarily as permanent forest lands, or have other possible utilities. (2) Placing of all federal lands of forest character under coördinated administration. Consolidation of federal ownerships within the various units of management, in order that the objectives of service may be obtained at the least economic outlay. (3) Federal management should provide for the improvement and development of the forests' beneficial contributions of the form often termed, "forest influences." These are watershed protection; influence on climate, such as on rainfall; protection against calamities such as floods, etc.; influence for health, culture, and recreation. Wolff stressed the point that these influences never will be of direct or tangible profit financially and that federal forest management is wholly justifiable from these standpoints alone, hence are paramount objectives.

The next group of benefits are usually, though not necessarily, susceptible of financial gain. Management is needed (1) to help provide a timber supply to meet the requirements of the consumer first, and of the industry second; (2) to develop and encourage such uses of forest land, as for example, grazing, which can be enjoyed concurrently with timber production and the benefits from "forest influences."

A third group of objectives is to attain their usefulness as a stimulus, example, or proving ground to other agencies handling forest lands.

Wolff closed his remarks by emphasizing that federal forest lands are first, the nation's property, that they are secondly lands before they are forests, and that the management of the federal forests should be based on the broad view of land utilization for service of which forestry, though important, should after all be only one of the aims.

H. G. Ade,
Reporter for
Northern Rocky Mountain Section.

Shepard to Tour Europe

Ward Shepard, who has been engaged during the past year on special conservation work for Gifford Pinchot, has resigned. Shepard plans to spend a year in Europe on studies of forest legislation and economics, and will sail with his family on May 30th.

FORTHCOMING EVENTS

31st Annual Meeting
Society of American Foresters
December 29-31, 1931
New Orleans, La.

Annual Meeting
Georgia Forestry Association
May 20-21, 1931
Albany, Ga.

Joint Meeting
American Forestry Association
and
North Carolina Forestry
Association
June 2-4
Grove Park Inn, Asheville, N. C.

Section secretaries are welcome to use this box for announcing their meetings. Copy should be in the hands of the Editor or Executive Secretary one month before date of publication.

Elections to Membership

The following men have been elected to the grade of membership indicated.

ALLEGHENY SECTION

Junior Membership

Bull, W. Ira
Fatzinger, Richard P.
Kase, John C.
Russell, Paul H.
Segraves, William B.

APPALACHIAN SECTION

Junior Membership

Bullock, W. Paul
MacMaster, Maxwell, Jr.
Stoughton, Margaret C.

Senior Membership

Barrett, Leonard I.
Lodewick, John E.

CALIFORNIA SECTION

Junior Membership

Berriman, R. C. M.
Delaney, Frank B.
DeLapp, Virgil C.
Dooley, Fred J.
Ernst, Emil F.
Freeman, John R.
Friedhoff, William H.
Honeycutt, E. E.
Mendenhall, William V.
Schrader, George R.
Vetter, Victor P.

CENTRAL ROCKY MOUNTAIN SECTION

Senior Membership

Apgar, William B.
Mack, Charles B.

GULF STATES SECTION

Junior Membership

Putnam, J. A.
Sinclair, Jesse Donald

INTERMOUNTAIN SECTION

Junior Membership

Standing, Arnold R.

MINNESOTA SECTION

Junior Membership

George, Ernest J.
Miller, Howard A.
Neetzel, John R.

NEW ENGLAND SECTION

Junior Membership

Bernier, Joseph L.
Bramble, Wm. C.
Johnston, James W., Jr.
Percival, Warren E.
Sylvester, Earle

Senior Membership

Cronk, C. P.

NEW YORK SECTION

Junior Membership

Balizet, Clarence E.
Caldwell, John H.
Carpenter, Roswell D.
Diebold, Charles H.
Hoffman, George C.
Houghton, Charles E.
Hunt, Stuart S.
Mattison, Charles Wesley
Strait, Harrison G.
Yops, Chester J.

NORTH PACIFIC SECTION

Junior Membership

Briem, A. J.
Brinson, Paul A.
Crawford, Ralph W.
Eastman, A. W.
Elliott, Harry R.
Hall, C. C.
Hallin, William
Logan, Paul H.
McReynolds, Kenneth
Miller, Samuel L.
Miller, Vondis E.
Olsen, C. C.
Overby, Charles H.
Rainwater, Theodore H.
Voorhies, Glen

OHIO VALLEY SECTION

Junior Membership

Collins, Robert F.
Feeman, A. L.
Gillett, Frances
Groesbeck, Byron L.
Hawkins, John H.
Jenkins, Benj. C.
Martell, Eldred R.
O'Roke, Earl C.
Randall, Leslie R.
Swain, Charles E.

NORTHERN ROCKY MOUNTAIN SECTION

Senior Membership

Van Giesen, Chester L.

Announcement of Candidates for Membership

The following names of candidates for membership are referred to Junior Members, Senior Members, and Fellows for comment or protest. The list includes all nominations received since the publication of the list in the April Journal, without question as to eligibility; the names have not been passed upon by the Council. Important information regarding the qualifications of any candidate, which will enable the Council to take final action with a knowledge of essential facts, should be submitted to the undersigned before June 15, 1931. Statements on

different men should be submitted on different sheets. Communications relating to candidates are considered by the Council as strictly confidential.

FOR ELECTION TO GRADE OF JUNIOR MEMBER

Name and Education	*Title and Address*	*Proposed by*
Barnum, Oscar L. O. A. C., Corvallis, Special, 1921-1923.	District Forest Ranger, Modoc N. F., Cedarville, Calif.	California Sec.
Bays, Isaac R. Elementary School.	District Ranger, Sierra N. F., Northfork, Calif.	California Sec.
Beals, James B. Grammar and 3 yrs. H. S.	Forest Ranger, Rio Grande N. F., Antonito, Colo.	Central Rocky Mt. Sec.
Bell, W. B. Iowa State Teachers' Col., M.Di., 1899; U. of Iowa, A. B., 1902; M. S., 1903 and Ph.D., 1905.	Principal Biologist, Biological Survey, Washington, D. C.	Washington Sec.
Bennett, Carey H. B. S. F., U. of Idaho, 1929.	Junior Forester, Biological Survey, Washington, D. C.	Washington Sec.
Burton, C. Leslie B. S. F., U. of Idaho, 1930.	Junior Forester, Roach, Colo.	Central Rocky Mt. Sec.
Chittick, George D. B. S. F., N. Y. State, 1929.	Junior Forester, Biological Survey, Washington, D. C.	Washington Sec.
Crebbin, Alfred K. B. S. F., U. of Calif., 1928.	Senior Forest Ranger, Sierra N. F., Northfork, Calif.	California Sec.
Dale, Wm. P. H. S. and special courses.	Principal Forest Ranger, Hot Springs, Ark.	Ozark Sec.
Erickson, E. S. Colo. School of Agri., 1924.	Forest Ranger, Rio Grande N. F., South Fork, Colo.	Central Rock Mt. Sec.
Farley, Philip E. B. S. F., U. of Maine, 1928.	Field and Office work for R. L. Whitney, Westbrook, Maine.	New England Sec.
Fathman, A. Stewart, Washington U.; N. Y. State, B. S. F., 1926.	Forestry and Sales Promotion, T. Y. Moss Tie Co., St. Louis, Mo.	Ozark Sec.
Gilbert, Karl School of Mines, Rapid City, S. D.	Sr. Forest Ranger, Las Animas Dist., San Isabel N. F., La Veta, Colo.	Central Rocky Mt. Sec.
Graw, Jack B. S. F., Oregon State, 1929.	Junior Forester, Nebraska N. F., Halsey, Nebr.	Central Rocky Mt. Sec.
Hancock, Charles E. B. S., N. Y. State, 1927.	Consultant and Supervisor, New London, Conn.	New England Sec.
Handy, Ernest L. B. S. F., N. Y. State.	Forester, N. Y. Power & Light Corp., Watervliet, N. Y.	New York Sec.
Hedden, George W. Cornell, B. S., 1929, M. F., 1930.	Forester, U. S. Indian Service, Washington, D. C.	Washington Sec.
Hetzel, John E. B. S., Conn. Agri. Col., 1930.	Junior Scientific Aid, Northeastern Forest Exp. Station, Amherst, Mass.	New England Sec.
Hinkley, Frank R. B. S. F., U. of Maine, 1930.	Field and Office work, R. L. Whitney, Westbrook, Maine.	New England Sec.
Klein, C. Cyril Yale F. S. course, summer, 1925; courses at U. of Md., winter, 1928-1929.	City Forester, Frederick City, Maryland.	Allegheny Sec.
Krummes, William T. B. S. F., U. of Idaho, 1930.	Forester, Biological Survey, Washington, D. C.	Washington Sec.
Lemmon, Paul B. A., Botany, U. of Mont., 1930.	Junior Range Examiner, Nebr. N. F., Halsey, Nebr.	Central Rocky Mt. Sec.

Name and Education	*Title and Address*	*Proposed by*
Leonard, Dean H. 1½ semesters at Denver U.	Senior Forest Ranger, Hahns Peak Dist., Routt N. F., Steamboat Springs, Colo.	Central Rocky Mt. Sec.
Liersch, John E. B. A., 1926, B. A. Sc., 1927, U. of British Columbia. Working on M. F. at U. of Washington.	Junior Forester, B. C. Forest Service (On leave), Victoria, B. C.	North Pacific Sec.
Lloyd, Hugh C. B. S. F., U. of Maine, 1928.	Land Surveyor, Dept. of Consv. and Devel., Trenton, N. J.	Allegheny Sec.
Lloyd, Leslie D. B. S., Ore. State Col., 1929; M. F., U. of Mich., 1930.	Assistant on Silvicultural Research, Calif. For. Exp. Sta., Berkeley, Calif.	California Sec.
Longacre, A. M. B. S. F., Penn. State.	District Ranger, Palomar Dist., Cleveland N. F., Aguanga, Calif.	California Sec.
Marco, Herbert F. B. S. F., Cornell.	Graduate Student, Wood Technology, N. Y. State College of Forestry, Syracuse, N. Y.	New York Sec.
Marsh, A. Fletcher Ph.B., Yale, 1910; M. F., 1911.	Vice President, Marsh & Truman Lumber Co., Chicago, Ill.	Ohio Valley Sec.
Martin, Hugh E. B. S. F., Colo. Agri.	Forest Ranger, Nebraska N. F., Halsey, Nebr.	Central Rocky Mt. Sec.
Miller, George Yeates Institute.	Asst. Regional Forest Inspector, San Francisco, Calif.	California Sec.
Osterhout, W. Lyle Ohio Northern U., Civil Engineering.	Forest & Type Surveyor, Comm. of Mass., Orange, Mass.	New England Sec.
Read, Wayne B. B. S. F., U. of Calif., 1930.	Graduate Student in Forestry, U. of Calif., Berkeley, Calif.	California Sec.
Rissman, Albert J. B. S. F., Cornell U.	Junior Forester, Biological Survey, Tonawanda, N. Y.	Washington Sec.
Roberts, Floyd Thomas B. S. F., Mich. State, 1929.	Junior Forester, Nebraska N. F., Halsey, Nebr.	Central Rocky Mt. Sec.
Robinson, Frank A. U. of Calif. (Non-grad.)	Asst. Forest Supervisor, San Bernardino N. F., San Bernardino, Calif.	California Sec.
Sabine, H. Gray B. S. F., U. of Calif., 1930.	Agent, U. S. Bureau Entomology, Berkeley, Calif.	California Sec.
Salman, Kenneth A. B. S. (Entomology), 1924, Ph.D., 1930, Mass. Agri. Col.	Calif. Forest Exp. Sta., Univ. of Calif., Berkeley, Calif.	California Sec.
Samon, Judell M. Short course, forestry, Oregon State Col., 1922.	Assistant Forest Supervisor, Santa Barbara N. F., Santa Barbara, Calif.	California Sec.
Sargeant, Howard J. B. S. F., U. of Idaho.	Junior Forester, Biological Survey, Granger, Washington.	Washington Sec.
Smith, Ralph W. B. S. F., Penn. State, 1925.	Division Forester, Dept. of Highways, Montoursville, Pa.	Allegheny Sec.
Tyrell, Travis M. B. S. F., U. of Calif., 1928.	Asst. Ranger, Georgetown Dist., Georgetown, Calif.	California Sec.
Van Huizen, Peter J. B. S. F., U. of Calif., 1930.	Junior Forester, U. S. Biological Survey, Washington, D. C.	Washington Sec.
Vinton, Everett L. B. S. F., Iowa State, 1927; M. F., Yale, 1931.	Student, Yale University, New Haven, Conn.	New England Sec.
Wait, James M. High School.	Forest Fire Prevention Lecturer, Dover, Arkansas.	Ozark Sec.
Woodward, Doren E. B. S. F., U. of Idaho, 1930.	Junior Forester, Biological Survey, Washington, D. C.	Washington Sec.
Woodward, Howard T. B. A., New Hampshire U., 1921.	Forest Eng., Consulting and Timber Operator, Berlin, N. H.	New England Sec.

FOR ELECTION TO GRADE OF SENIOR MEMBER

Barrett, L. A. 1 yr. H. S., 1 yr. Business College. (Junior memer 1920.)	Asst. Regional Forester, Belmont, California.	California Sec.
Beeson, W. Russell B. A., Forestry and Botany, U. of Calif. (Junior member 1924).	Assistant to Asst. Regional Forester, U. S. F. S., San Francisco, Calif.	California Sec.
Ellis, Guerdon B. S. F., U. of Calif., 1923. (Junior member, 1925.)	Principal Forest Ranger, Saugus Dist., Angeles N. F., Newhall, Calif.	California Sec.
Foster, Clifford H. B. F., 1921, M. F., 1922, N. Y. State; M. F., Harvard, 1924. (Junior member, 1924.)	Director, Pack Demonstration Forest, Warrensburgh, N. Y.	New York Sec.
French, H. E. B. S., U. of Iowa; M. F., Yale. (Junior member, 1916.)	Forest Supervisor, San Isabel N. F., Pueblo, Colorado.	Central Rocky Mt. Sec.
Gibbs, J. A. B. S. F., Colo. State, 1923; M. S. F., Iowa State, 1927. (Junior member, 1926.)	Extension Forester, Asst. Prof. Forester, Storrs, Conn.	New England Sec.
Hurford, Archie W. B. S., U. of New Hampshire, 1925. (Junior member, 1928.)	State Leader, Blister Rust Control, Providence, R. I.	New England Sec.
Price, William S. Wyman's School of the Woods, U. of Calif. (3 mos.). (Junior member, 1921.)	Chief Lumberman, Plumas N. F., Quincy, Calif.	California Sec.
Smith, Leland S. Nat'l Univ. Law School, 2yrs. Advanced work in Ecology and Agrostology. (Junior member, 1928.)	Asst. Range Examiner, U. S. F. S., Nevada City, Calif.	California Sec.
Stafford, Earle Harvard, 1906-1907; U. of Switzerland, 1909-1910; Harvard School of Landscape Architecture, 1914-1916. (Junior member, 1927.)	Forest Supervisor, Mass. Dept. of Consv., Great Barrington, Mass.	New England Sec.
Thomson, R. B. B. S. F., U. of Minn., 1925; M. F., Yale, 1928. (Junior member, 1926.)	Asst. Forest Economist, Forest Taxation Inquiry, New Haven, Conn.	New England Sec.
Weber, Arnold N. B. S. F., 1923; M. S. F., 1926; U. of Calif. (Junior member, 1926.)	Junior Forester, Eldorado N. F., Placerville, Calif.	California Sec.
Wright, Ernest B. S. F., Oregon State, 1923; M. S. F., U. of Calif., 1928. (Junior member, 1924.)	Junior Pathologist, U. S. Forest Service, San Francisco, Calif.	California Sec.

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Aldo Leopold	Dec. 31, 1931	Stuart B. Show	Dec. 31, 1933
T. T. Munger	Dec. 31, 1931	Ralph S. Hosmer	Dec. 31, 1933
W. G. Howard	Dec. 31, 1931	Claude R. Tillotson	Dec. 31, 1933

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